STANDARDS DEVELOPMENT BRANCH OMOE
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ONTARIO MINISTRY OF THE ENVIRONMENT

WASTE MANAGEMENT BRANCH

Old Waste Disposal Site Studies
Phase II , Part I ,
Verification Study

CENTRAL REGION

Final Report

TD
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.O43
C46
1983
phase II
part I
MOE

MORRISON BEATTY LIMITED

GORE & STORRIE LIMITED

TD
897.5
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C46
1983
phase II

Old waste disposal site studies :
central region.

76906

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morrison beatty limited
consulting engineers and hydrogeologists
4500 dixie road, unit 12a, mississauga, ontario L4W 1V7 (416-624-9308)

December 5, 1983

Ministry of the Environment
Waste Management Branch,
135 St. Clair Avenue West,
2nd Floor,
Toronto, Ontario.

Attention: Mr. R. Gotz, Director

Dear Sir:

re: Verification Study
Old Disposal Site Identification Program
Our File No. 262-811

We are pleased to submit our Final Report for the above noted study. Twenty (20) copies of the report have been included as specified in the Terms of Reference.

The report includes a comparison of the preliminary study methodology with the Verification Study methodology, presents the Verification Study results, compares the results of the two studies and presents general conclusions on the overall study findings.

TheTechnical Data Catalogue which accompanies this report includes all data compiled during this study and the results of the preliminary field study. We are enclosing 5 copies of the Technical Data Catalogue. If you require additional copies, please let us know.

Yours very truly,
MORRISON BEATTY LIMITED

Nancy Rennie

Nancy J. Rennie, B.E.S.

Brian Beatty

Brian W. Beatty, P.Eng.

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VERIFICATION STUDY REPORT

1.0 INTRODUCTION

This report outlines the results of Phase II, Part I, Verification Study for the Waste Site Identification Study. Phase I was completed by the Ministry of the Environment in 1979. It involved an inventory of waste disposal sites throughout Ontario which have not been in operation since 1971.

Phase II, Part I involved preliminary studies by consultants at selected old disposal sites identified in the Phase I work. This study was carried out using a specified field methodology for all sites. The main purpose was to determine if a public hazard existed at the sites. This study was completed in the fall of 1980.

The purpose of the Phase II, Part I, Verification Study is to establish whether or not the methodology used in the preliminary field studies is a valid method to determine the impacts of old waste disposal sites. The three sites chosen for this work included one where a hazard had been identified (Site 7071, Mississauga); where no hazard had been identified but was suspected to exist (Site 3045, East York) and where no hazard was anticipated (Site 7060, Georgetown).

2.0 METHODOLOGY OF THE PHASE II, PART I STUDY

In 1980, Morrison Beatty Limited and Gore & Storrie Limited carried out a preliminary field study at 54 former waste disposal sites in Central Region. These sites had been in operation from the 1920's to the 1970's and were identified during the Phase I study in 1979.

The method of study used to assess the site impacts is summarized below:

A. Background Review - A review of background data was carried out prior to the field investigation. This included all Ministry of the Environment and Municipal data; topographic maps; aerial photographs; geological reports and land title information. This was supplemented by personal interviews with municipal employees or residents of the area.

B. Field Investigations - The field investigations included visual assessments of vegetation stress, leachate seeps, ground settlement, paved areas, and proximity to buildings. Landfill settlement, vegetation stress and interviews were used to determine the approximate limits of fill.

Surface water and domestic wells within 100 m of the landfill were analyzed for pH, conductivity, alkalinity, chloride and iron (leachate indicators). In the case of streams, both upstream and downstream samples were taken.

Methane was checked in the field using an explosimeter. A small diameter steel bar was driven into the landfill to a depth of about one metre. A methane reading was taken from the barhole as soon as the bar was removed. One reading per acre of landfill area was required.

Methane monitoring in buildings within 100 m of the landfill site was also required. The testing took place in the subsurface levels of the buildings. Obvious gas seepage points were monitored. The total field investigation for each site was completed in one day.

C. Data Analysis - Based on the accumulated data from the background review, interviews and field investigations, assessments were made on the potential for a hazard to the public. The 54 sites were placed in one of the following catagories:

- no hazard risk
- potential hazard risk
- probable hazard risk
- definite hazard risk

As well, a series of general observations of leachate and methane impacts were made during the Phase II, Part I investigation. These related to the impacts of old landfill sites. Recent research has been limited mainly to new or on-going sites.

3.0 THE VERIFICATION STUDY

The purpose of the Verification Study is to evaluate the methodology used in the preliminary field studies as described in the previous section. In order to prove or disprove the assessments and conclusions drawn from the preliminary study, a long-term detailed approach was taken. Three sites were chosen by the Ministry of the Environment for the Verification Study in Central Region.

A detailed outline of the field investigations carried out during this study is included in Section A of the Technical Data Catalogue. In general, it included a full hydrogeological impact study of each landfill site with the major emphasis on methane migration. The following chart outlines the methodology used to complete the major tasks of the Verification Study compared to the methodology used in the preliminary field investigations.

	METHODOLOGY	
TASK	Verification Study	Preliminary Study
1. Identify Leachate Seeps	- Site reconnaissance	- Site reconnaissance
2. Identify Vegetation Stress	- Site reconnaissance	- Site reconnaissance
3. Hydrology & Drainage Characteristics	- Site reconnaissance - Topographic plan review	- Site reconnaissance
4. Local Geology	- Test drilling - Literature review	- Literature review
5. Determine Limits of Fill	- Test drilling - Sampled boreholes - Old aerial photographs	- Visual - vegetation stress - settlement - interviews
6. Composition of Fill	- Test drilling - Sampled boreholes	- Interviews with municipality and residents
7. Type of Cover Material	- Test drilling - Samples	- Visual
8. Hydrogeologic Characteristics	- Observation wells - Monitored water levels	- Literature review - Site reconnaissance
9. Volume of Waste	- Test drilling to confirm extent and depth of fill material	- Interviews - Estimates of natural site topography
10. Leachate Quality and Quantity	- Observation wells - Two sampling dates - Detailed lab analysis - Surface water samples within 100 m - Water budget analysis	- Surface water within 100 m - Leachate seep samples - Field tests for leachate indicators - No study of leachate quantity
11. Methane Concentrations	- Permanent gas probes - Off-site probes in strategic locations and depths - 12 month monitoring period to examine annual variations - Investigatons into climatic affects - Gas pumping test	- Temporary barholes - 1 per acre - Methane readings from barhole - Maximum depth 1 metre - On-site only - One reading in fall season
12. Methane Seepage into Buildings	- Foundation gas probes - Monitoring in buildings if problem identified in foundation probes.	- Testing for methane in all buildings 100 m from site at time of field visit

4.0 STUDY RESULTS

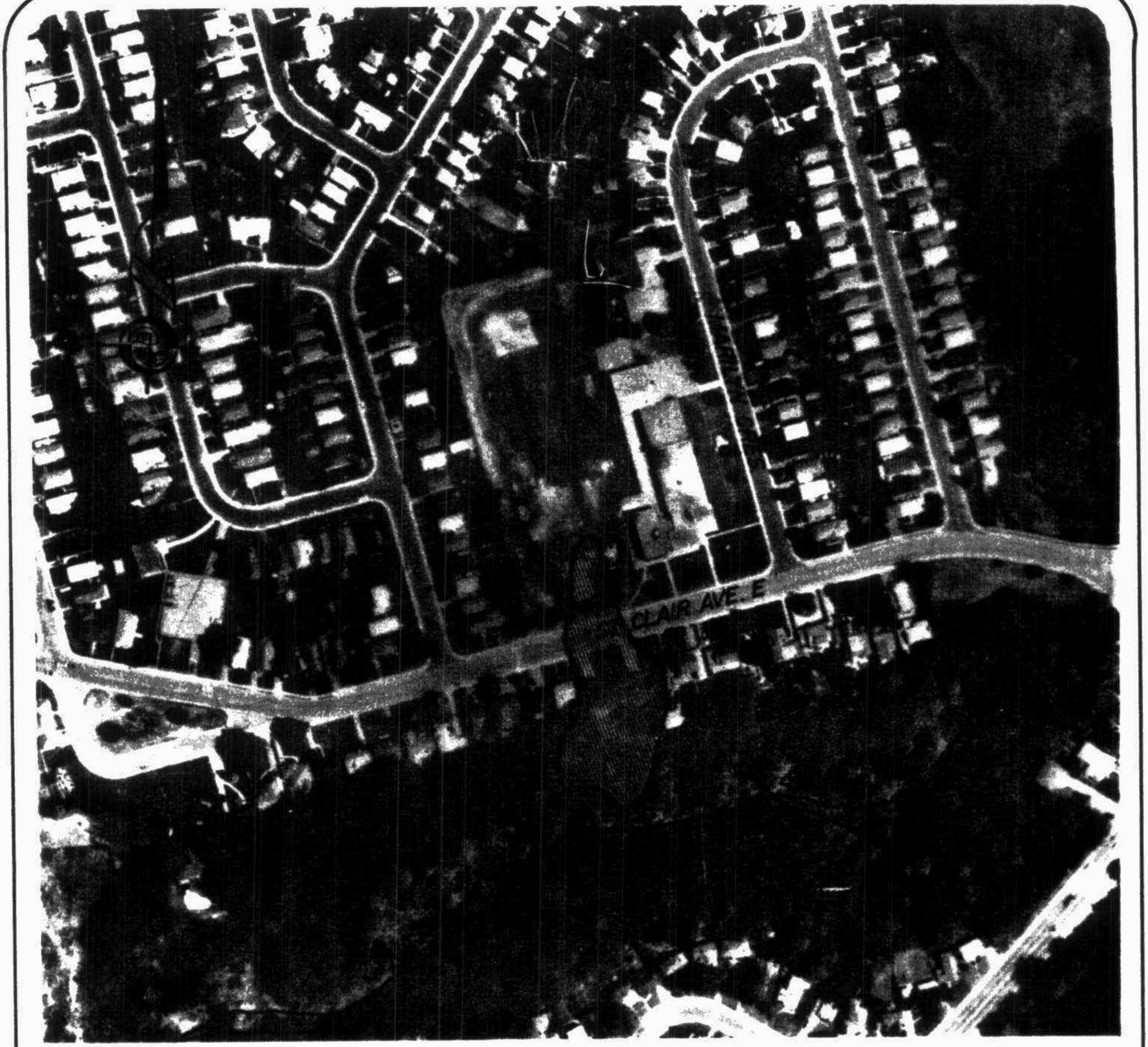
4.1 East York, Site No. 3045

4.1.1 Background

This site is located in the Borough of East York near the intersection of Marilyn Crescent and St. Clair Ave. East. The regional location of the site is shown in Figure A-1.

St. Clair Ave. was constructed over part of the former disposal area. A section of the Presteign Heights Public School play yard and portions of the properties of 2577, 2579, and 2581 St. Clair Ave. East are also underlain by the disposal site. The site and surrounding land uses can be seen on the enlarged aerial photograph, Figure A-2.

Formerly, the site was a steep ravine which extended several hundred metres north of the main valley of Massey Creek. The site was operated by the former Township of East York in the late 1940's and early 1950's. During this time, many local ravines in the Metro area were filled with domestic waste; the end purpose being land reclamation. The associated environmental hazards were not known at that time.



▨ LANDFILL BOUNDARY

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 3045 EAST YORK

AIR PHOTO LOCATION

PROJECT NO. 262 -811
APR. 1983

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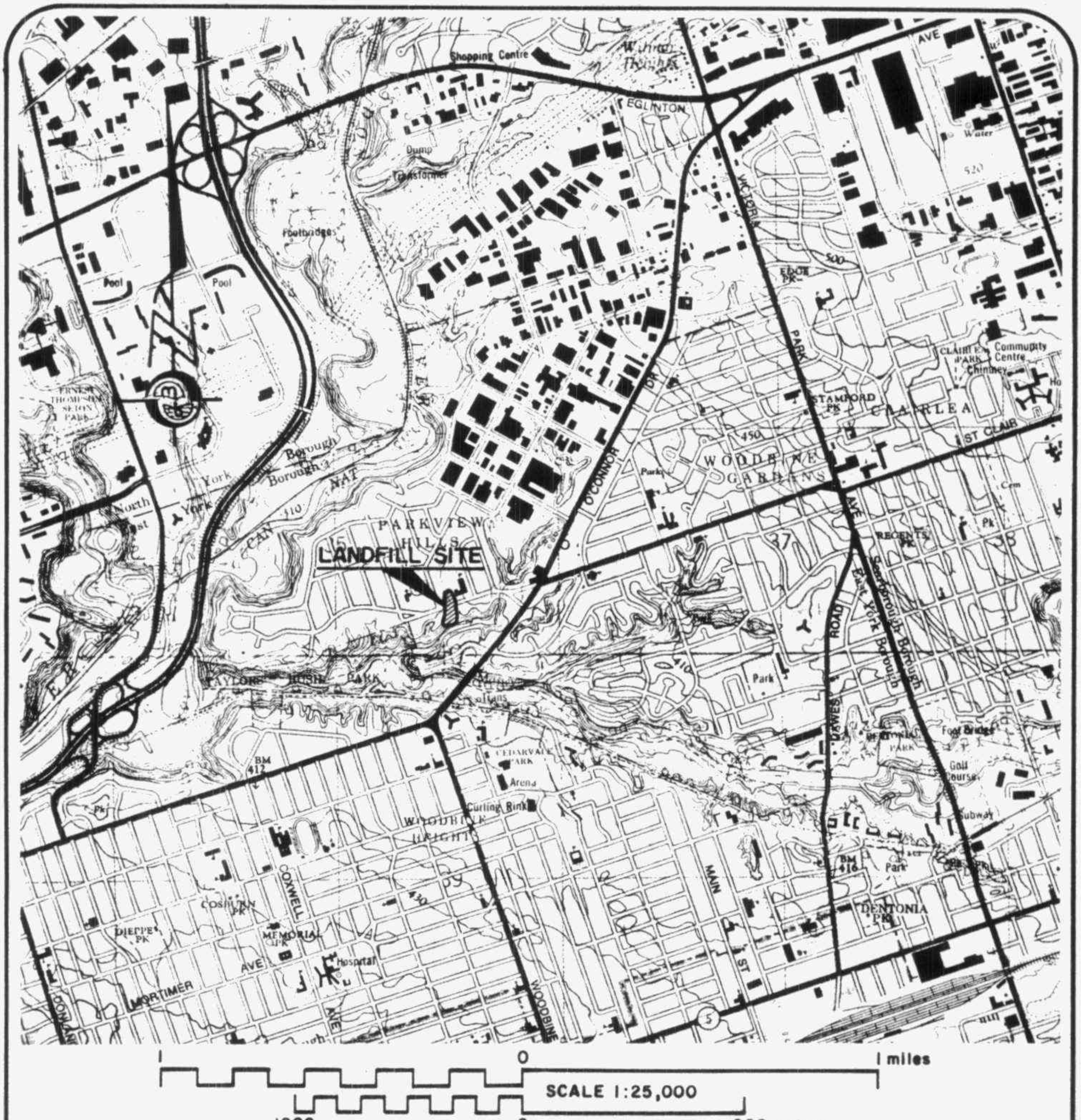
consulting engineers and hydrogeologists

A2



Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 3045 EAST YORK

TOPOGRAPHIC LOCATION

PROJECT NO. 262-811	MAR. 1983
morrison beatty limited consulting engineers and hydrogeologists	**A1**

4.1.2 Hydrogeologic Setting

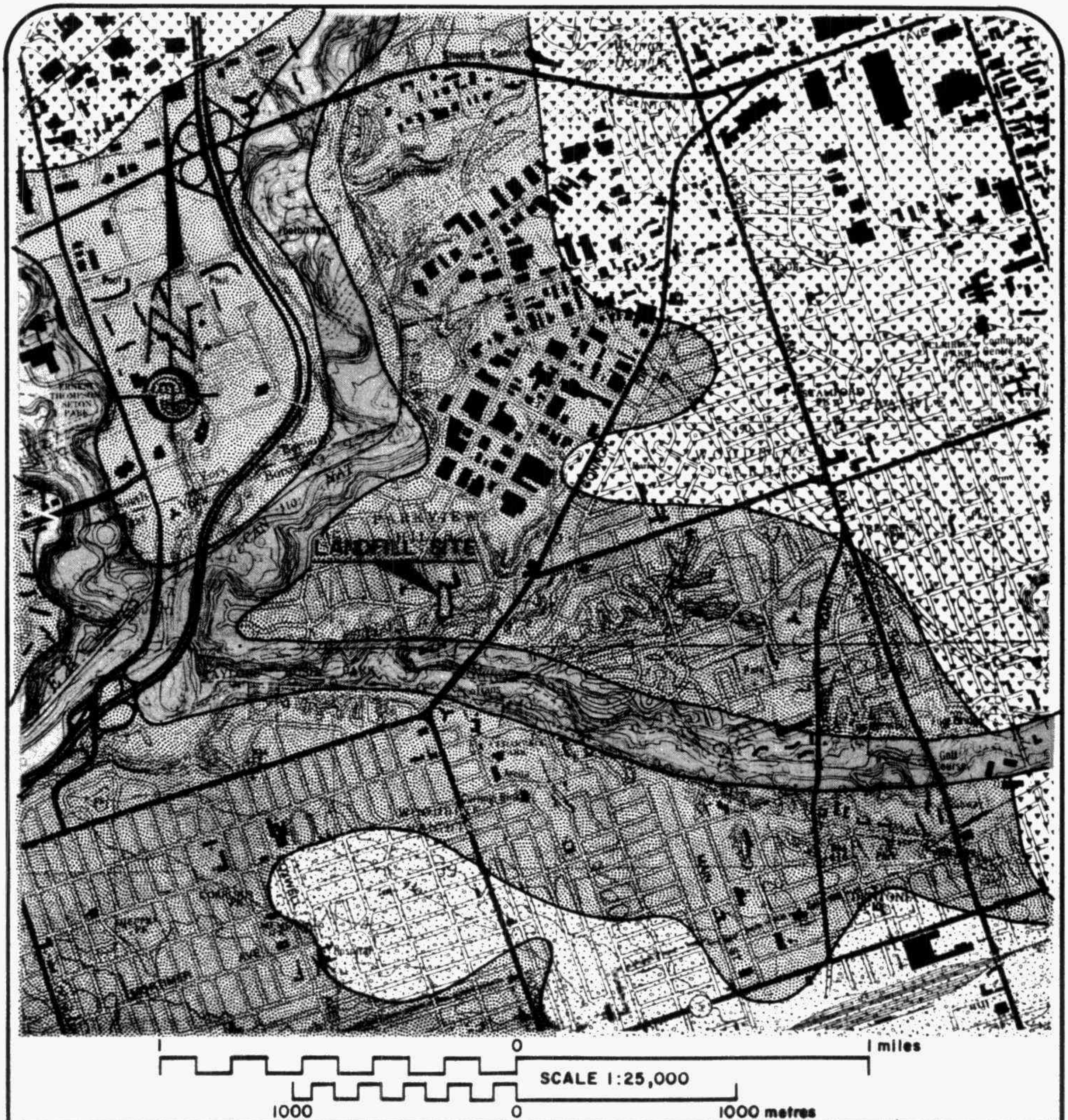
The site is underlain by shallow water deposits of glacial Lake Iroquois consisting of sand and silty sand. Regionally, this deposit is quite thin. The Thorncliffe Formation which is an older, deeper water deposit of silt and clay, underlies this sand. Local geology is shown on Figure A-3..

The drilling program at this site confirmed the sand deposit. However, it did not encounter the deeper clay and silt deposits. Some recent alluvial deposits of the former ravine were encountered in one borehole (see BH P1 in Section B, 1.0 of the Technical Data Catalogue).

Overburden depths are over 45 m in the area. The underlying bedrock is shale of the Dundas Formation.

The site is within the watershed of Massey Creek which flows at the base of the landfilled area. Massey Creek eventually enters the Don River downstream of the site. The area north of St. Clair Ave. E. is drained by storm sewers, however, drainage from the south section of the site is to Massey Creek.

The depth to water table at this site ranges from 6.4 m to 9.9 m below surface. Water levels in the three observation wells at this site were taken on two occasions. Locally, groundwater discharges to Massey Creek. Regionally, deep groundwater flow paths are south to Lake Ontario.



LEGEND

▨ SAND

▽ TILL

⁘ SAND & GRAVEL

■ ALLUVIUM

Source: Sharpe, D.R. 1980

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 3045 EAST YORK

GEOLOGY

PROJECT NO. 262-811	MAR.1983
morrison beatty limited consulting engineers and hydrogeologists	A3

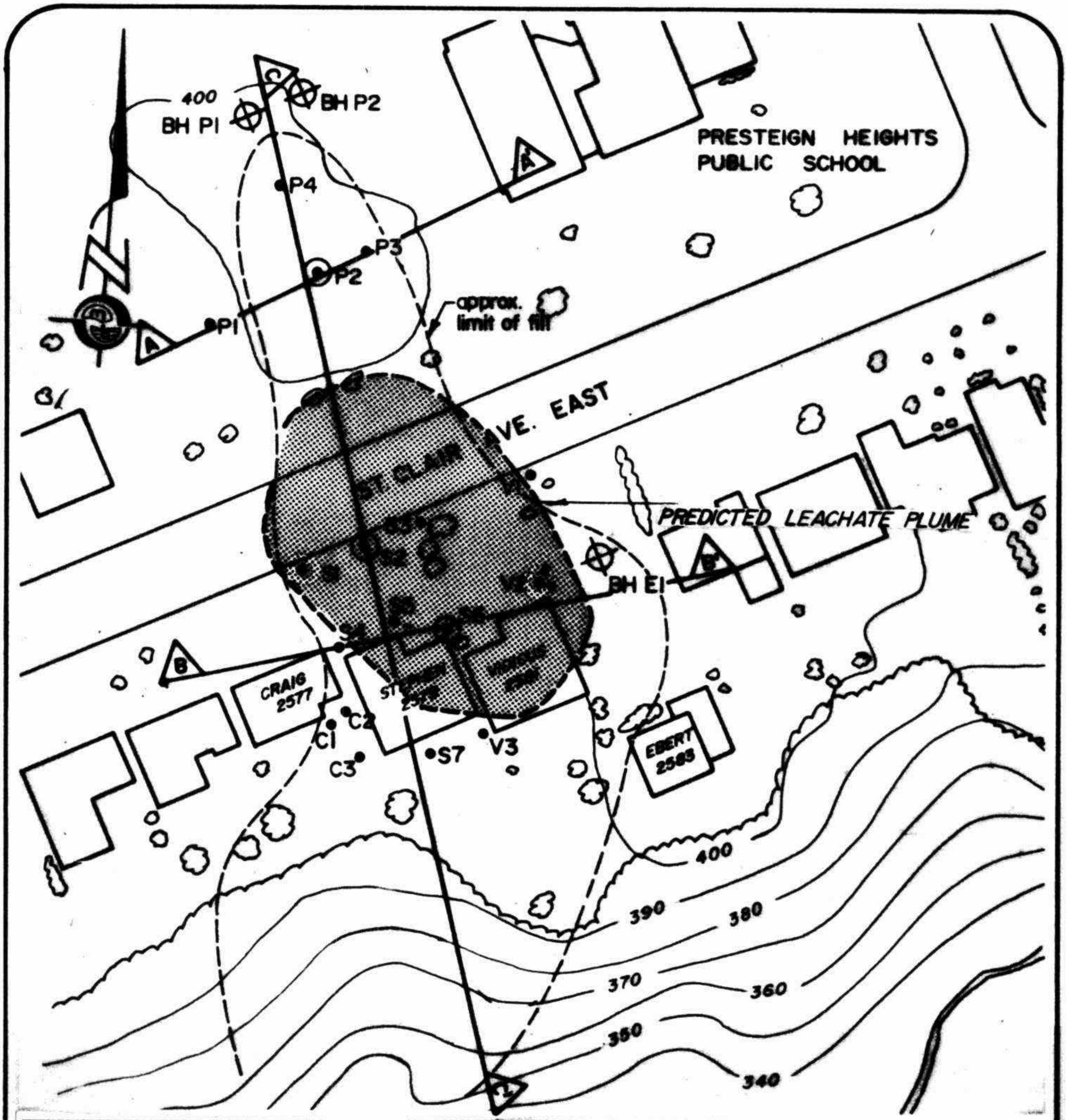
4.1.3 Disposal Site Detail

North of St. Clair Avenue E., the site has been graded to slope to the south. The play yard at this point is depressed at least 1.5 m below the road elevation. The yards of 2577, 2579 and 2581 St. Clair E. are at the same level as the road. The yards behind these houses extend about 30 m to a steep bluff on Massey Creek. The creek is about 10 m below.

Test drilling at the site showed the landfill refuse as black, odourous material consisting of mainly ash and other well decomposed wastes. This is typical of areas landfilled during the 1940's and 50's. The borehole logs (Section B, 2.0, Technical Data Catalogue) include detail on the type of landfill refuse and backfill material encountered at the site.

The limits of fill were confirmed during the test drilling and are shown on Figure A-4. The landfill extends about 85 m into the school yard at Presteign Heights Public School. Other areas of the school yard have been backfilled and regraded with local material; however, the landfill material is confined to the area outlined on Figure A-4. Depths of landfill in the school yard range from 0 - 8.1 m.

South of St. Clair Ave. E. the landfill area widens and deepens following the former ravine. Test drilling showed landfill material beneath the residence at 2759 St. Clair E. more than 10.9 m deep. We understand that the piles were driven only about 9.3 m when this house was constructed. It has experienced extensive settlement resulting in uneven flooring and cracked plaster and brickwork. The driveway and backyard has settled from the house foundation.



LEGEND

- ● Gas Probe
- ⌖ **Borehole**
- ○ **Observation Well**
- △ **Cross-section Location**

30 0 30 60 m
SCALE 1:1200

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 3045 EAST YORK

GAS PROBE LOCATION PLAN

PROJECT NO. 262-811 APRIL, 1983

morrison beatty limited
consulting engineers and hydrogeologists

A4

The residence at 2581 St. Clair E. is also completely underlain by landfill material. The fill material is shallower here and the original sand deposit is encountered between 3.4 and 9.3 m. The piles were probably driven into this deposit as settlement problems have not occured.

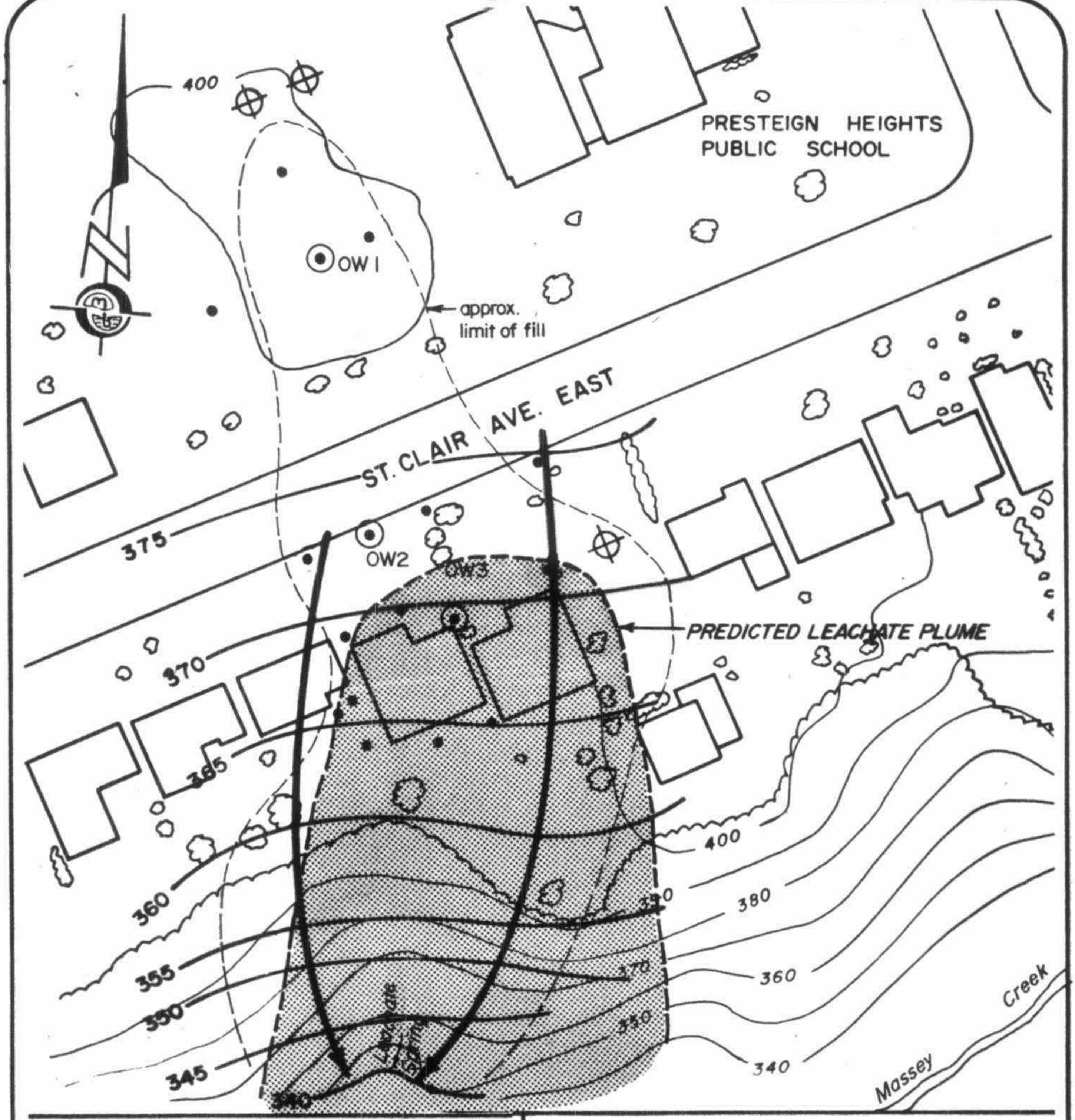
The landfill material extends a short distance onto the property at 2583 St. Clair (to the east) but the house has been built on original ground. To the west at 2577 St. Clair, some landfill underlies the garage and part of the backyard. The landfill is much shallower at this point as it is near the crest of the former ravine.

The position of these residences and school in relation to the landfilled ravine are shown in the cross-sections (Figures A-6 to A-8).

4.1.4 Identified Impacts

Methane

Identification of methane impacts involved the installation of 28 gas probes at this site. Initially, 23 probes were installed at 12 locations. A shallow and a deep probe were nested in separate boreholes at each location. Details on the construction and probe depths are included in Section B, 1.0 of the Technical Data Catalogue. The location of each probe is shown on Figure A-3. When explosive levels of methane (5-15% by volume) were detected in the shallow probes near the houses at 2579 and 2581 St. Clair E., a portable drill was used to install 5 additional probes in the backyards of these two homes. Probes were also installed at the rear of 2577 St. Clair E.



LEGEND

- ● Gas Probe
- ⌖ Borehole
- ○ Observation Well
- — Groundwater Contour
- ← Flow Arrow

30 0 30 60 m
SCALE 1:1200

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 3045 EAST YORK

OBSERVATION WELLS & WATER TABLE

PROJECT NO. 262-811
APRIL, 1983

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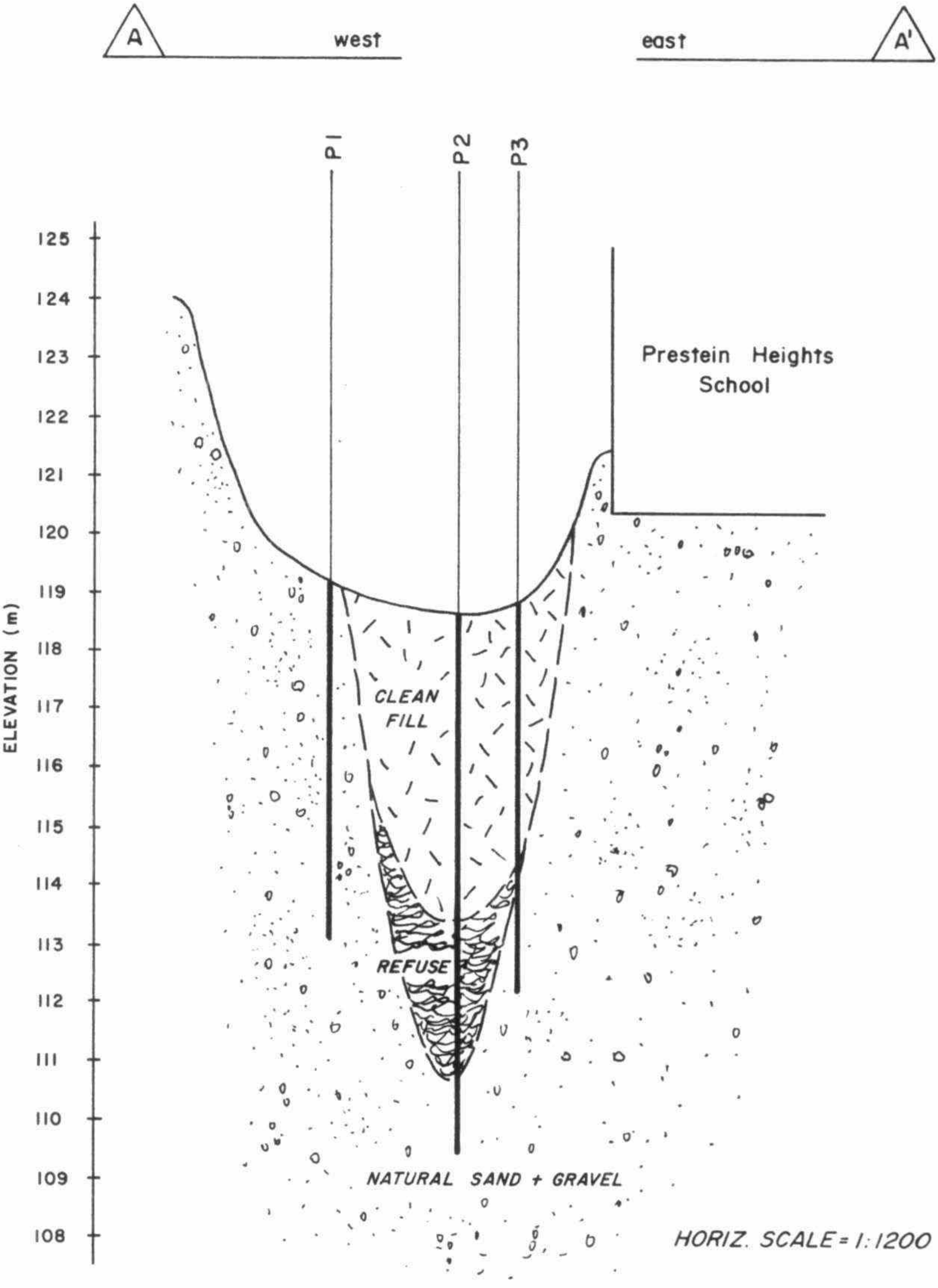
consulting engineers and hydrogeologists

A5



CROSS SECTION A - A'

MINISTRY OF THE ENVIRONMENT
Verification Study Project No. 262-811
Site: No. 3045, East York

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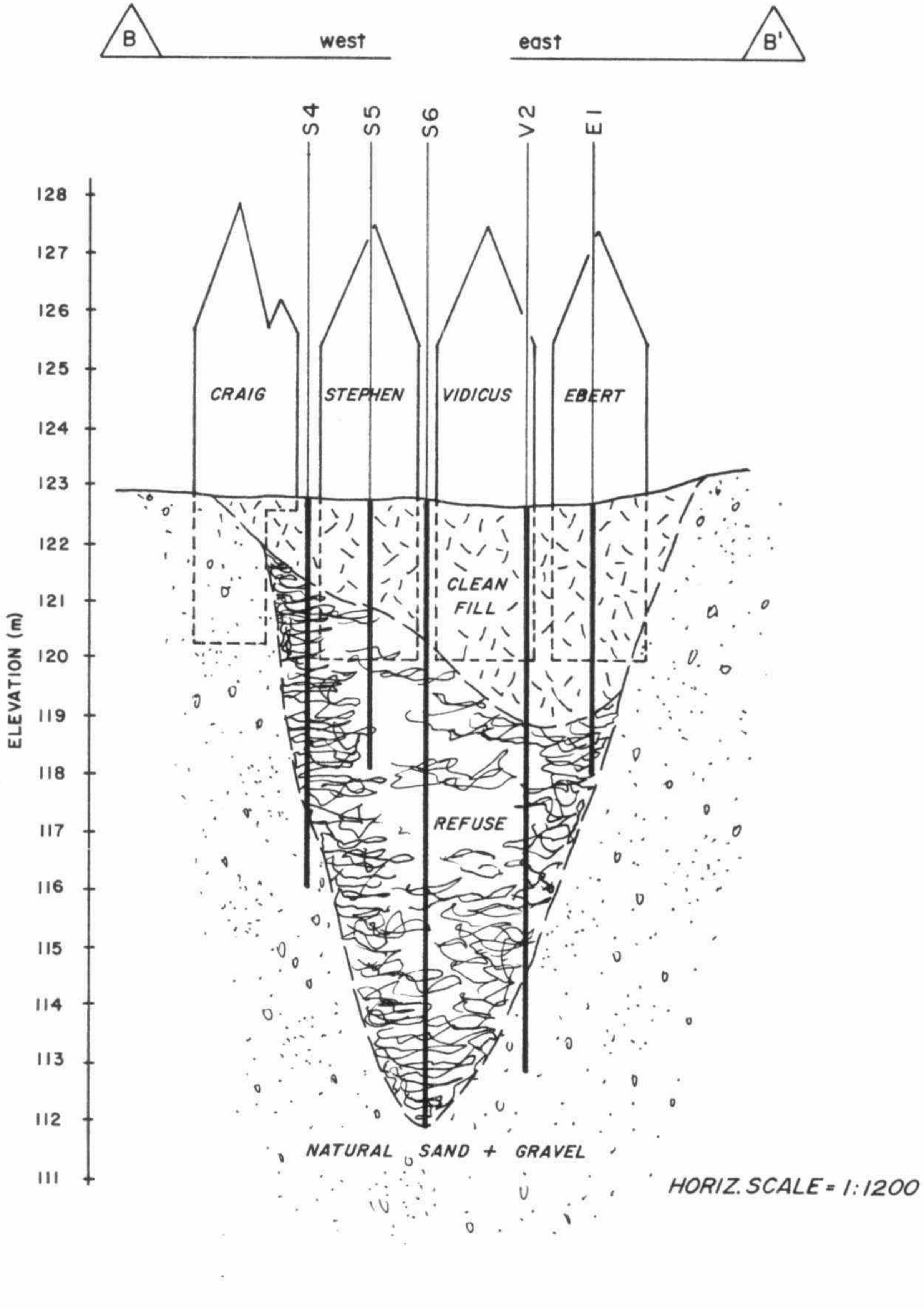
A6



CROSS SECTION B - B'

MINISTRY OF THE ENVIRONMENT
Verification Study Project No. 262-811
Site: No. 3045, East York

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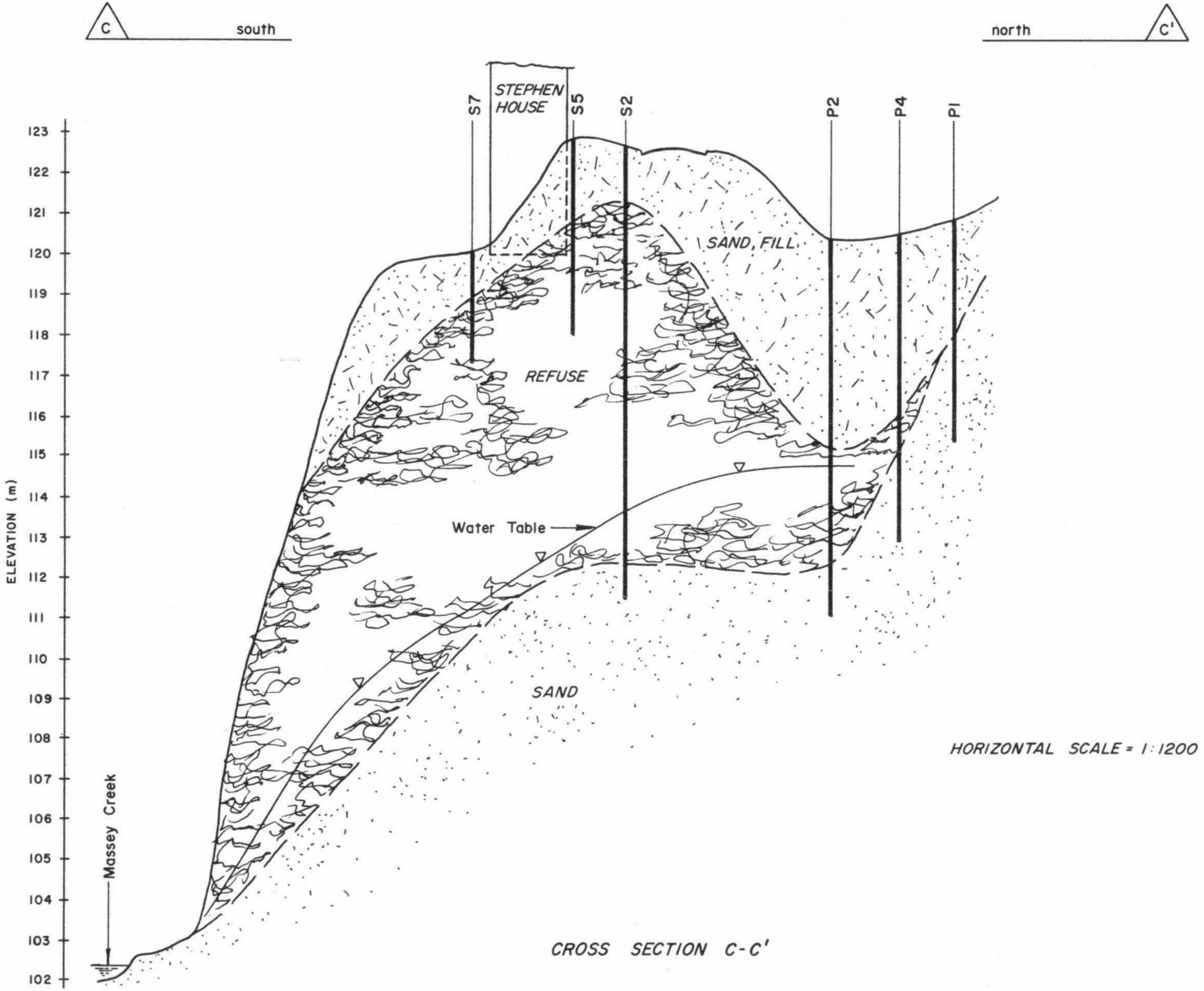
consulting engineers and hydrogeologists

A7



HORIZONTAL SCALE = 1:1200

CROSS SECTION C-C'

MINISTRY OF THE ENVIRONMENT
Verification Study Project No. 262-811
Site: No. 3045, East York

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consulting engineers and hydrogeologists

A8

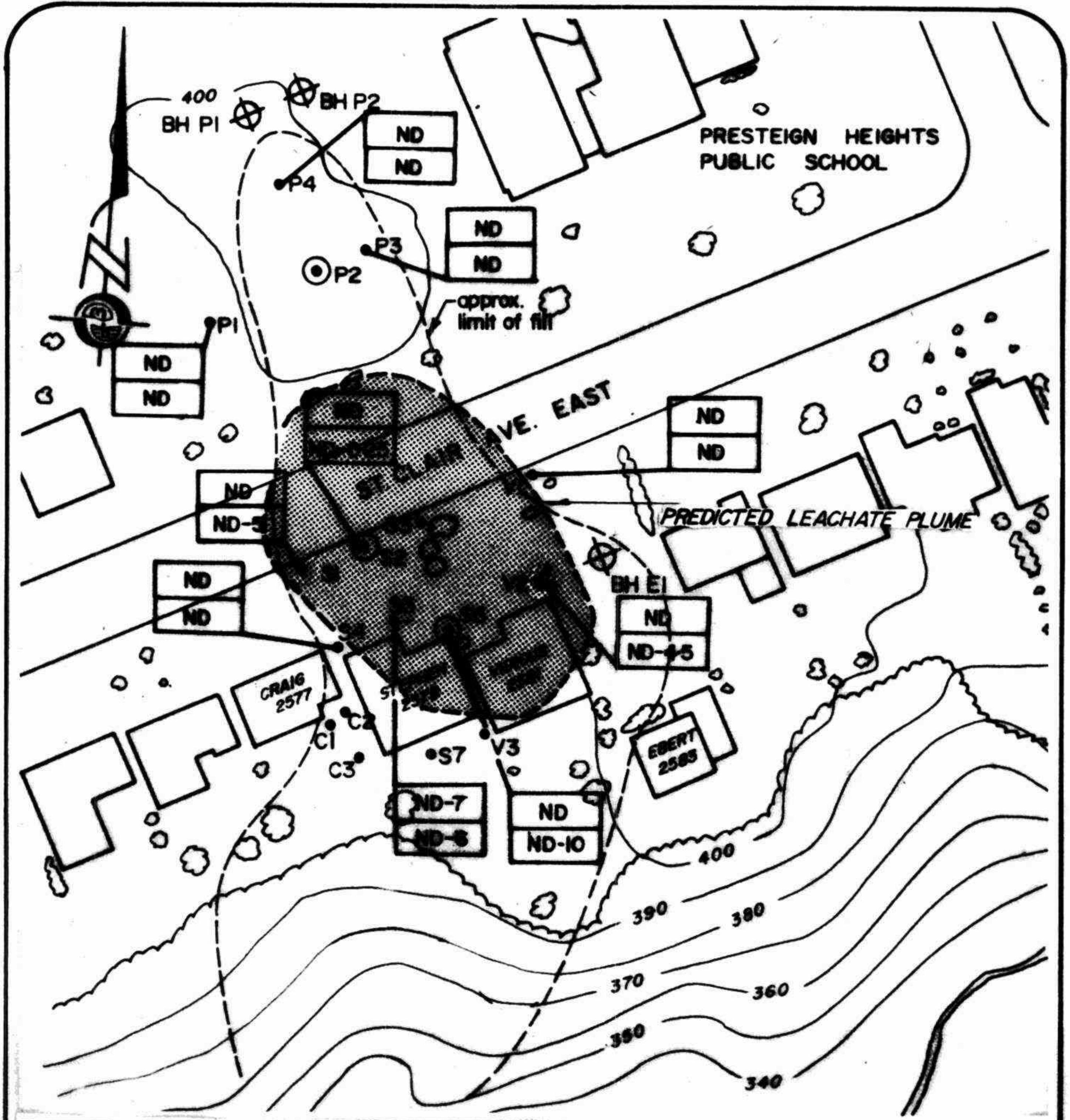
A trace amount of methane was detected on one monitoring occasion in Presteign Heights school yard. The reading was below the explosive level and was taken at a probe located in the refuse material (P3-d). At no time was methane detected in probes beyond the fill limit.

Methane was detected in both shallow and deep probes in the front yards of 2579 and 2581 St. Clair Ave. Concentrations of methane fluctuated between zero and the upper limit of the explosive range (15%). The exception was the deep probe at S6 which remained in the explosive range throughout the entire monitoring period. Methane was detected in concentrations between 0.5 to 10% in the shallow foundation probe at S6 for the initial four months of the monitoring program but were non-detectable for the remainder of the study.

The shallow probes (2.0 - 2.7 m), installed in the backyards of these residences, showed zero methane on all monitoring dates. The predicted methane plume is shown on Figures A-9 and A-10.

Soil pressures were monitored at selected probes throughout the monitoring program. The pressures ranged from -0.03 to +0.03 inches of water. On the majority of monitoring dates there was no pressure differential between the soil/landfill pressure and atmospheric pressure.

Relationships between advancing high and low pressure systems were studied using Environment Canada's daily pressure readings from the Toronto International Airport (see Section A, 3.0, Technical Data Catalogue). No obvious co-relations or patterns between a change in atmospheric pressure and landfill pressures or methane concentrations were evident. Precipitation events and frozen cover did not appear to effect the soil/landfill pressures or the methane migration pattern at this site.



LEGEND

- ● Gas Probe
- Borehole
- ○ Observation Well

SHALLOW PROBES

Range in methane concentration
- frozen ground
- unfrozen ground

ND not detected
INACC inaccessable

30 0 30 60 m
SCALE 1:1200

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 3045 EAST YORK

METHANE CONCENTRATIONS - SHALLOW PROBES

PROJECT NO. 262-811	APRIL, 1983
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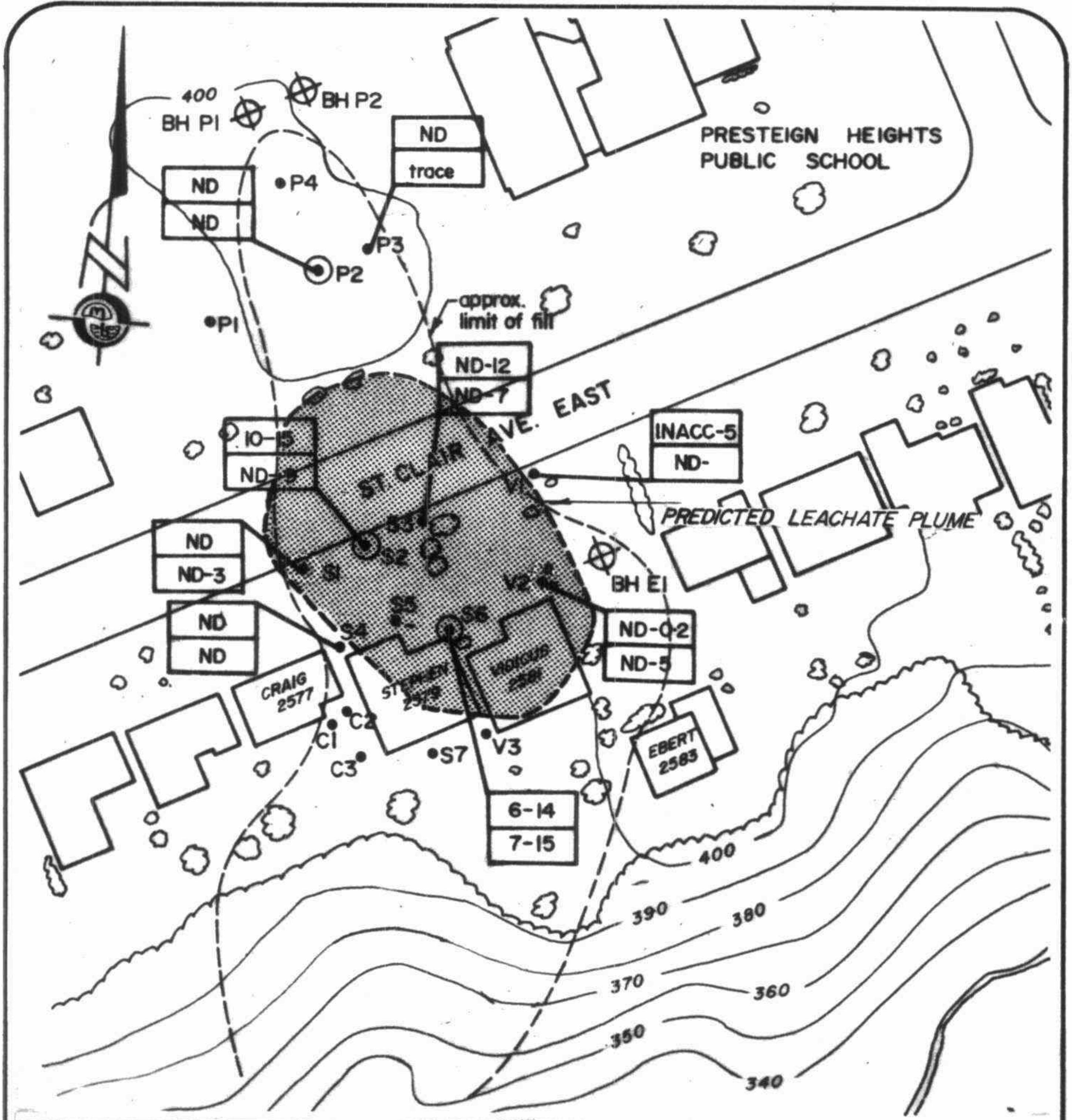

LEGEND

- • Gas Probe
- ⊕ Borehole
- ○ Observation Well

DEEP PROBES

Range in methane concentration:
- frozen ground
- unfrozen ground

ND not detected
INACC inaccessable

30 0 30 60 m
SCALE 1:1200

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 3045 EAST YORK

METHANE CONCENTRATIONS-DEEP PROBES

PROJECT NO. 262-811

APRIL, 1983

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consulting engineers and hydrogeologists

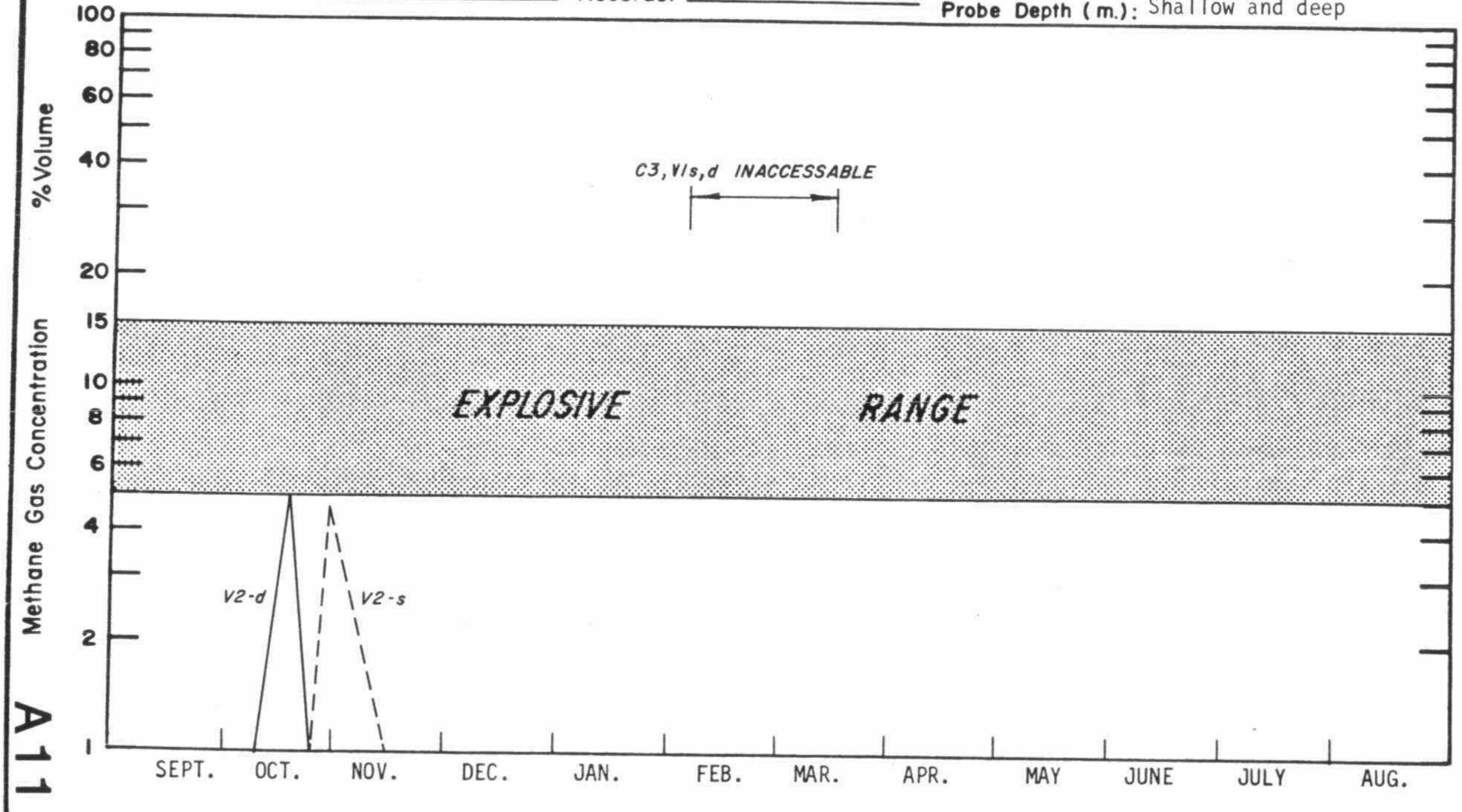
A10

L6-090681

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

Methane Gas Probe Data

Client Ministry of the Environment
Landfill location East York
Job No. 262-811
Recorder
Gas Probe No. V1, V2, V3, P1, P2, P3, P4, C1, C2, C3
Probe location: refuse ☐ **soil** ☐
Probe Depth (m.): Shallow and deep



A11

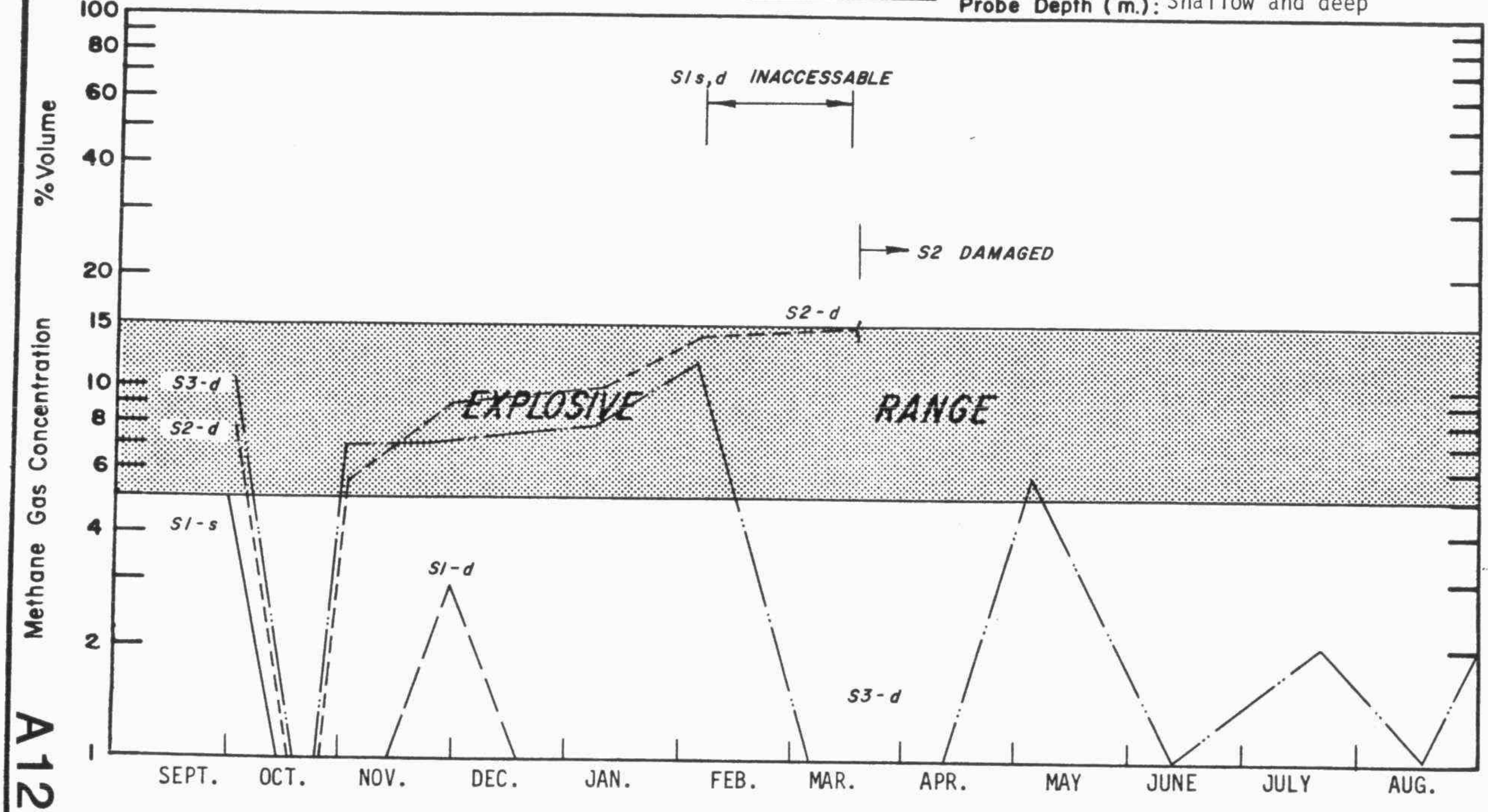
Time Interval in months

LG-090681

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

Methane Gas Probe Data

Client Ministry of the Environment	**Job No.** 262-811	**Gas Probe No.** S 1 S 2 S 3	
Landfill location East York	**Recorder**	**Probe location: refuse** ☐	**soil** ☐
		Probe Depth (m.): Shallow and deep	



A12

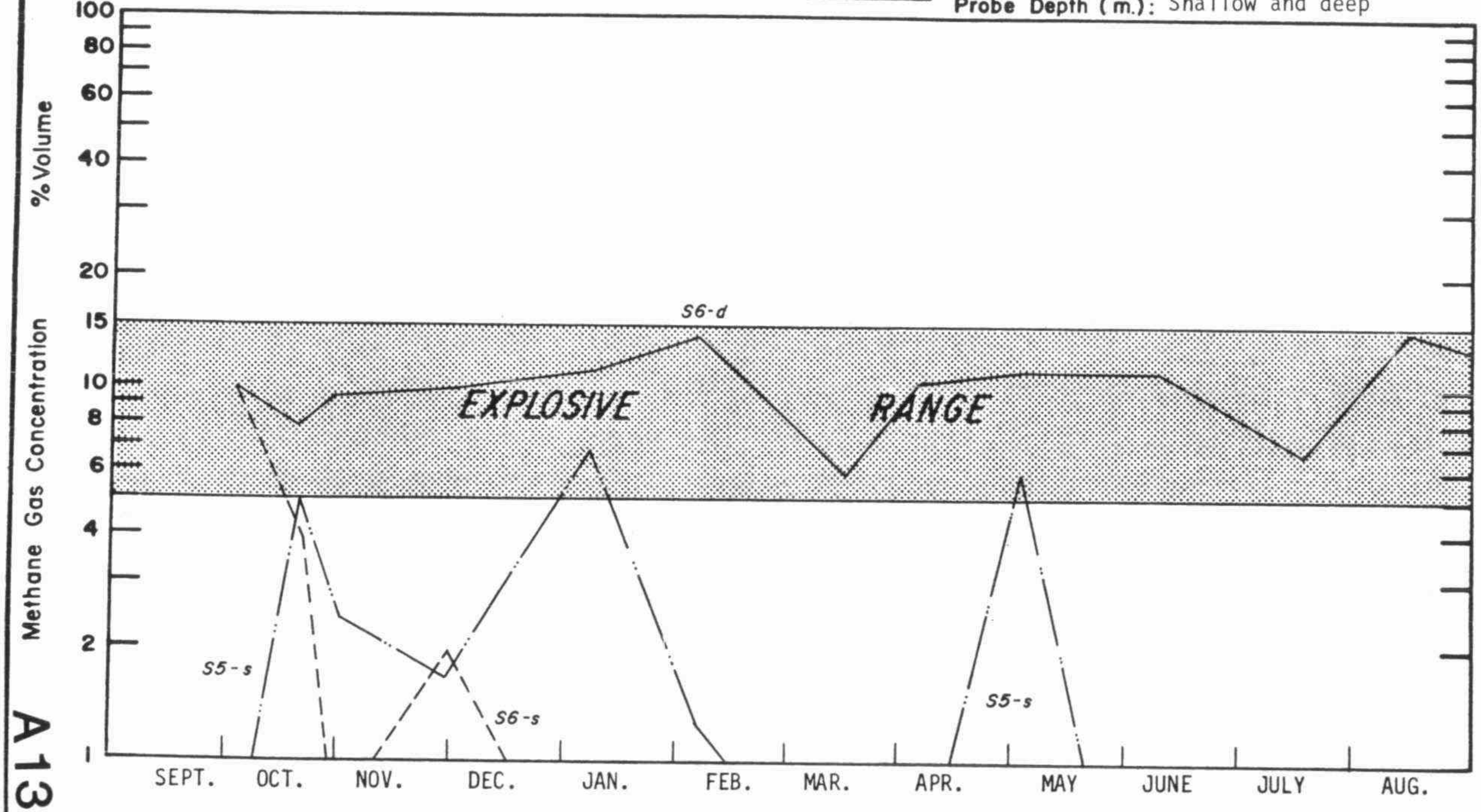
Time Interval in months

L6-090681

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

Methane Gas Probe Data

Client Ministry of the Environment
Landfill location East York
Job No. 262-811
Recorder
Gas Probe No. S4, S5, S6, S7
Probe location: refuse ☐ soil ☐
Probe Depth (m.): Shallow and deep



Time Interval in months

A13

Figure A-9 and A-10 summarize the range of methane concentrations at each probe. They have been separated according to shallow and deep probes. Figures A-11, A-12 and A-13 are graphic presentations of the methane concentrations over the twelve month period. Methane concentrations peak on various monitoring dates; however, there is no apparent relationship between the peaks and time of year. Periods when probes were inaccessable or damaged are also indicated on these graphs. Tables of the monitoring results are found in Section B, 2.0 of the Technical Data Catalogue.

Leachate

Observation wells and surface water were sampled on two separate dates (Fall 1981 and Spring 1982). There are three observation wells at this site and three surface water monitoring points (upstream, downstream and leachate seep). The analyses are included in Section B, 3.0 of the Technical Data Catalogue. Water levels were taken to determine groundwater flow paths at the site. These are found in Section B, 4.0, Technical Data Catalogue. Predicted groundwater flow paths are shown on Figure A-5.

Water quality analyses show that OW 1 and OW 2 represent background quality. OW 2 is slightly elevated in some parameters but it is still within the expected background range. The water sample from OW 3 shows some typical leachate constituents. Conductivity, chloride, TOC and iron increase and there is also a typical decrease in sulphate. However, leachate strengths are low compared to leachate quality at young landfill sites. A more detailed discussion of the relationshp between landfill age and leachate quality is included in Section 5.1.

There is a significant leachate seep at the base of the ravine. If forms an iron stained stream which flows directly to Massey Creek (see Figure A-5). Water samples were taken from the leachate seep and from upstream and downstream locations in Massey Creek. The analyses of these surface water points indicated that there is no significant impact on Massey Creek. Water quality from the leachate seep shows some dilution when compared to OW 3 (in the refuse) and major dilution when the seepage water enters Massey Creek. Assimilation is rapid and there is no significant change in water quality between upstream and downstream sampling points. High chlorides in Massey Creek are probably due to road salting in winter months.

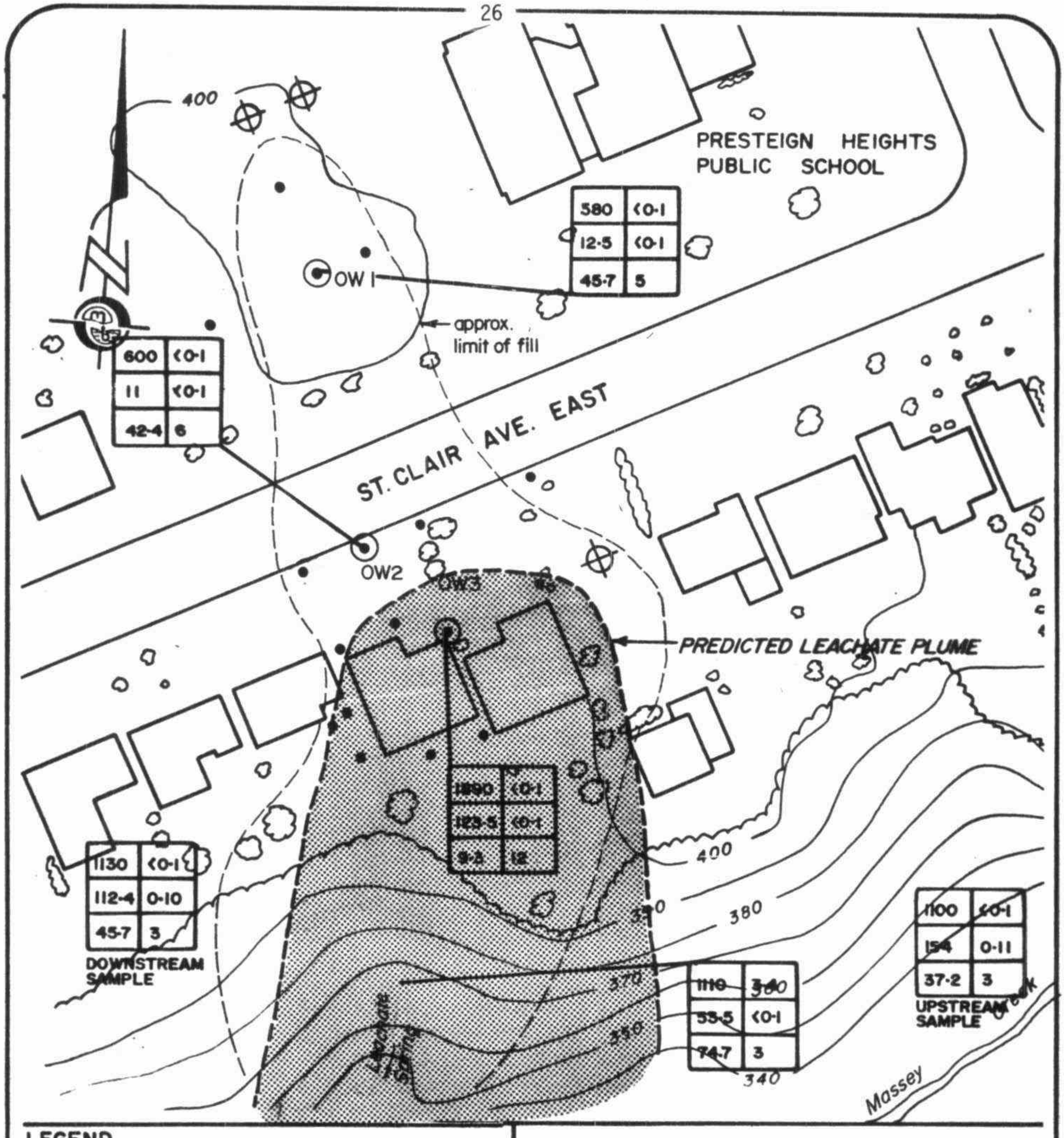
Selected water quality parameters are shown on Figure A-14 along with the predicted leachate plume.

4.1.5 Gas Pumping Test

The methane gas pumping test at Site 3045 took place on October 19, 1981. The pumping well (S5-d) is located in front of the house at 2579 St. Clair Ave. E. and is about 4.6 m deep. The construction details are included in Section A of the Technical Data Catalogue.

The well was pumped at a pumping rate of 8 cc/s or 13 cfm for 60 minutes. Methane was removed from all shallow probes (1.5 m depth) within 20 minutes and from all deep probes by the end of the test.

The rapid evacuation of methane reflects the relatively small size of this disposal area. It appears that a high recharge of atmospheric air through the soil cover caused the sudden depletion of methane. Graphs showing pressure change over time; percent methane over time and the pressure drawdown are shown on Figures A-15 and A-16. Graphs are included for both the shallow and deep probes.



LEGEND

- ● Gas Probe
- ⊕ Borehole
- ○ Observation Well

Conductivity	*Cond.	NH_4	Free Ammonia
Chlorides	Cl	P	Total Phosphorous
Sulphates	SO_4	TOC	Total Organic Carbon

Concentrations in mg/l except as noted * umhos/cm

30 0 30 60 m
SCALE 1:1200

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 3045 EAST YORK

GROUNDWATER QUALITY

PROJECT NO. 262-811

APRIL, 1983

morrison beatty limited
consulting engineers and hydrogeologists

A14

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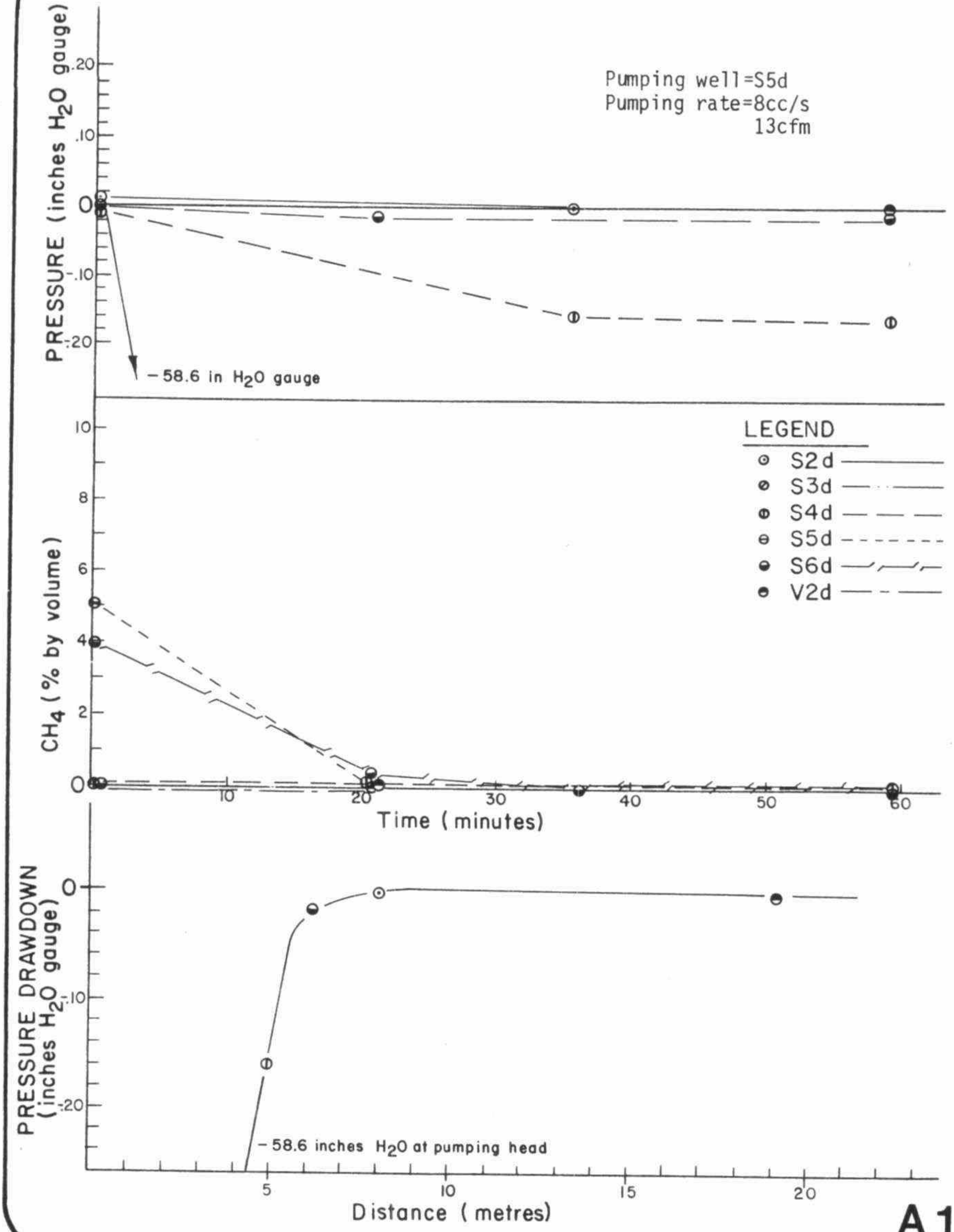
consulting engineers and hydrogeologists

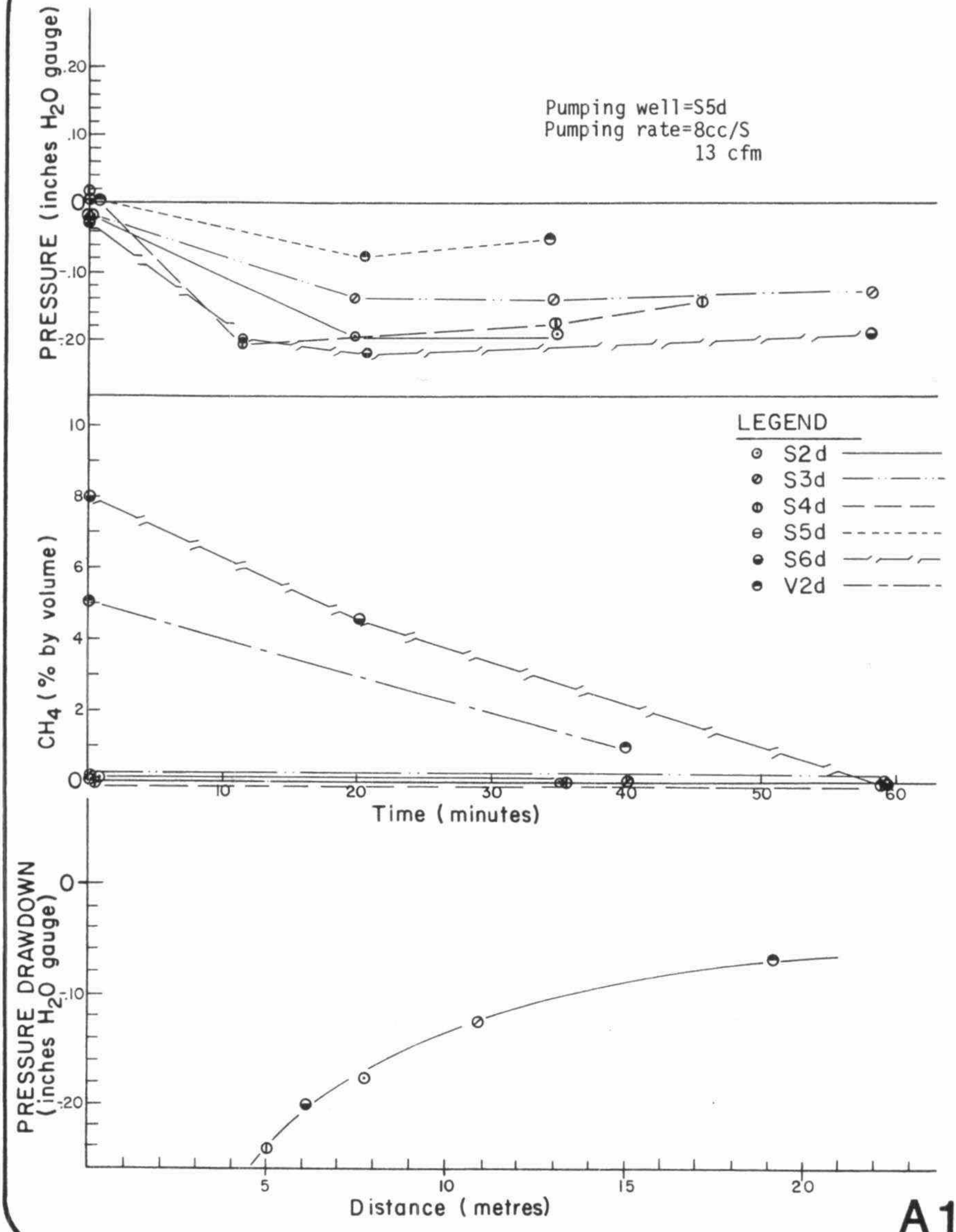
GAS PUMPING TEST
M.O.E. VERIFICATION STUDY
SITE NO. 3045, St. Clair
Shallow probes (1.5 m below surface)



A15

morrison beatty limited
consulting engineers and hydrogeologists

GAS PUMPING TEST
M.O.E. VERIFICATION STUDY
SITE NO. 3045 , St. Clair
Deep probes (6.0 m below surface)



A16

4.1.6 Potential Impacts

The Verification Study has identified the impacts that presently exist at the East York site. In doing this, some of the potential hazards outlined in the preliminary study were confirmed. Others, such as migration of methane into the school building were found not to exist.

Methane migration may occur into the houses at 2579 and 2581 St. Clair Ave. East. When methane was detected within the explosive range in the foundation probes, the Ministry of the Environment, the residents and the Borough of East York were notified. The residents were told of the potential hazard and remedial measures, verbally and by letter. We understand gas detectors were installed in three residences (2577, 2579, and 2581 St. Clair Ave. E.) by the municipality. Morrison Beatty Limited submited a plan for a proposed gas evacuation system to the Borough of East York.

Methane is not expected to migrate beyond the fill limits. Therefore, there should be no impact on 2577, 2583 St. Clair Ave. E. or Presteign Heights Public School.

Leachate seepage is not causing an impact on Massey Creek at the present time. Leachate strengths will continue to decay below the present levels.

4.1.7 Recommendations

A methane hazard has been identified at this site. Although a definate hazard was not identified by the preliminary study, the site was placed in the "possible hazard risk" category requiring additional study. This was due to the investigators' familarity with methane problems. This site can now be classed a "probable hazard risk".

The following remedial actions are recommended.

1. Install a gas evacuation system around all residences situated on the landfill area. One system installed at the site will service all effected homes.
2. Establish a regular methane monitoring program. This should include monitoring of established gas probes as well as routine checks in the effected residences. The monitoring program should continue for a period time after the gas evacuation system is installed.
3. Determine a method by which the "limits of fill" and the requirements for methane controls can be permanently recorded in public records.

4.1.8 Comparison of Results

The preliminary field study results are included in Section B, 5.0 of the Technical Data Catalogue. The following chart compares the results obtained from the Verification Study with the preliminary results:

	STUDY RESULTS	
TASK	Preliminary Study	Verification Study
1. Identify Leachate Seeps	- one major seepage point at base of fill - flows to Massey Creek	- unchanged
2. Identify Vegetation Stress	- vegetation stress throughout school yard	- vegetation stress is not due to the presence of methane gas
3. Hydrology & Drainage	- drainage in north is to manhole, south portion drains to Massey Creek south of site	- unchanged
4. Local Geology	- sand overburden, former Lake Iroquois deposit	- unchanged
5. Determine Limits of Fill	- landfill probably extends for full length of school yard, width uncertain	- limits of fill were defined, extends into school yard for a short distance
6. Composition of Fill	- domestic waste	- consists mainly of ash and cinders, well decomposed domestic waste
7. Cover Material	- local sandy soils - depth unknown	- unchanged - depth confirmed
8. Hydrogeologic Characteristics	- groundwater flow assumed to the south - depth to water table probably 15 m	- groundwater flow confirmed to south - depth to water table range from 6.4 to 9.9 m

9. Volume of Waste	- depth, length and width of fill area (ravine) unknown	- dimensions of former ravine were determined - volume of waste approximately 50,000 m^3
10. Leachate Quality	- no impact on Massey Creek - simple lab analyses	- confirmed with detailed lab analyses
11. Methane Concentrations	- no methane detected - odours reported in house - no methane detected in any residence - probable hazard was identified	- methane detected within explosive range at house foundations - no methane recorded in house or outside of fill limits - no significant change caused by frozen ground cover (seasonal variations) - no impact on school
12. Potential Impacts	- methane migration into homes and school	- possible methane impact on two homes - no methane impact on school - no leachate impact on stream
13. Remedial Recommendations	- further study required	- gas evacuation system recommended - monitoring program recommended

4.2 GEORGETOWN, Site No. 7060

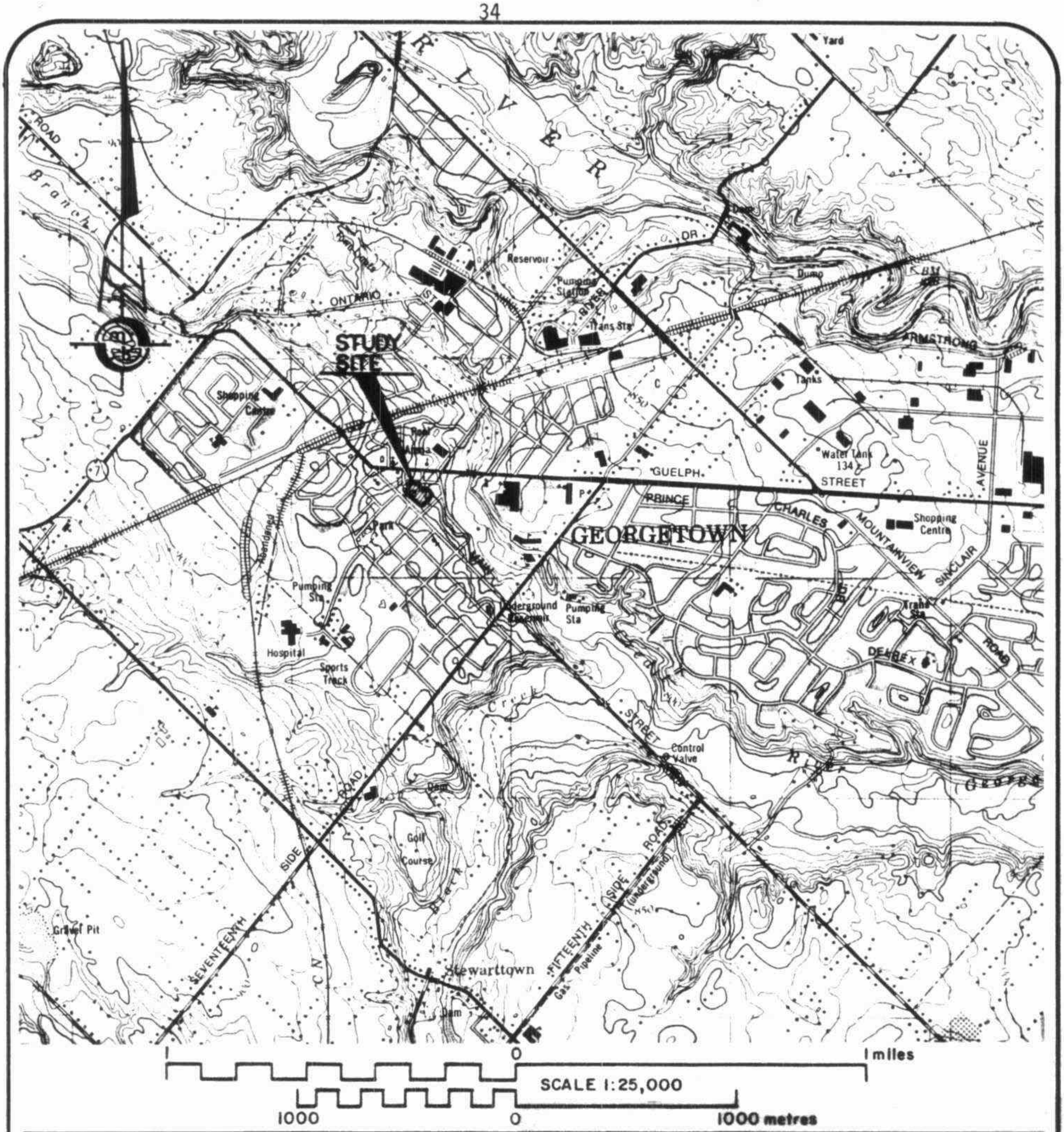
4.2.1 Background

This old disposal area is located in Halton Hills, formerly the Town of Georgetown. It is between Main Street, Mill Street, and Bank Street and is presently used as a parking area for the Main Street shopping district. The regional setting of the site is shown in Figure B-1. Figure B-2 is an enlarged aerial photograph and shows the present site use and surrounding land uses.

Adjacent land uses include stores and a hotel along Main Street which back onto the former disposal area. There is a florist, bowling alley, and a restaurant backing the site along Mill Street. The Halton Hills Hydro building and parking/storage area also backs the site.

The site was a small ravine which joined a branch of the Credit River east of the site. Based on interviews, landfill material was placed only in the area outlined in Figure B-2. The remainder of the ravine to the west and east was filled with local clean fill and has since been developed. The ravine once continued west under the existing Silvers Department Store and Main Street. The former stream is now contained within a storm sewer which empties into the main river.

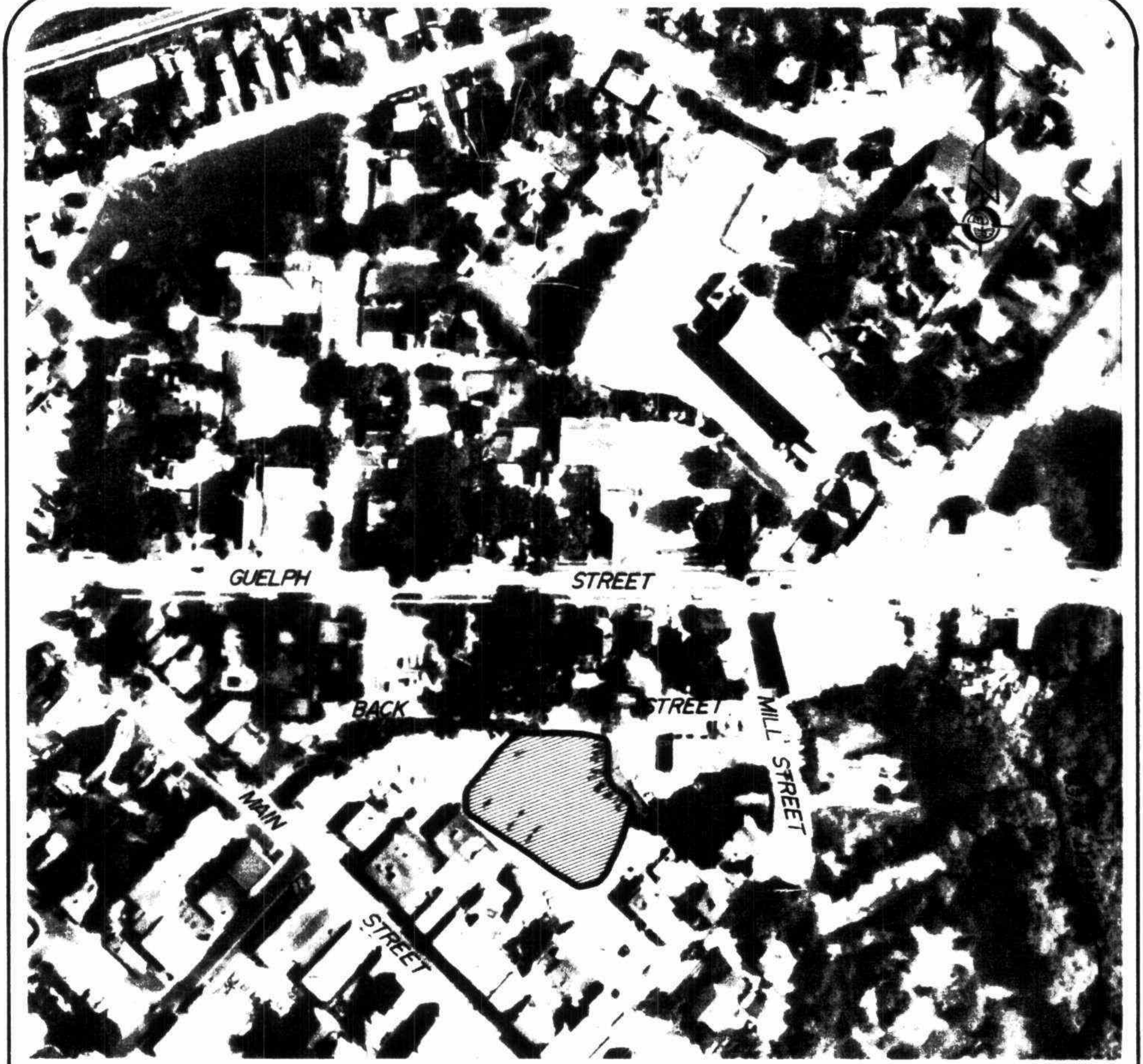
The site was operated by the former Town of Georgetown up until the 1940's for domestic waste disposal. Numerous fires in the landfill were reported. The site was paved in the 1950's for use as a parking lot. The site now has numerous owners including Silvers, Lacada Estates, the Georgetown Hotel, and Halton Hills Hydro.



Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7060 GEORGETOWN

TOPOGRAPHIC LOCATION

PROJECT NO. 262-811	APR. 1983
morrison beatty limited consulting engineers and hydrogeologists	**B1**



▨ LANDFILL BOUNDARY

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7060 GEORGETOWN

AIR PHOTO LOCATION

PROJECT NO. 262 -811

APR. 1983

morrison beatty limited
consulting engineers and hydrogeologists

B2

4.2.2 Hydrogeologic Setting

The Georgetown site is located on a glacial spillway of sand and gravel. The sand and gravel is well sorted as it was deposited in fast flowing water at the front of a melting ice lobe. Local geology is shown on Figure B-3.

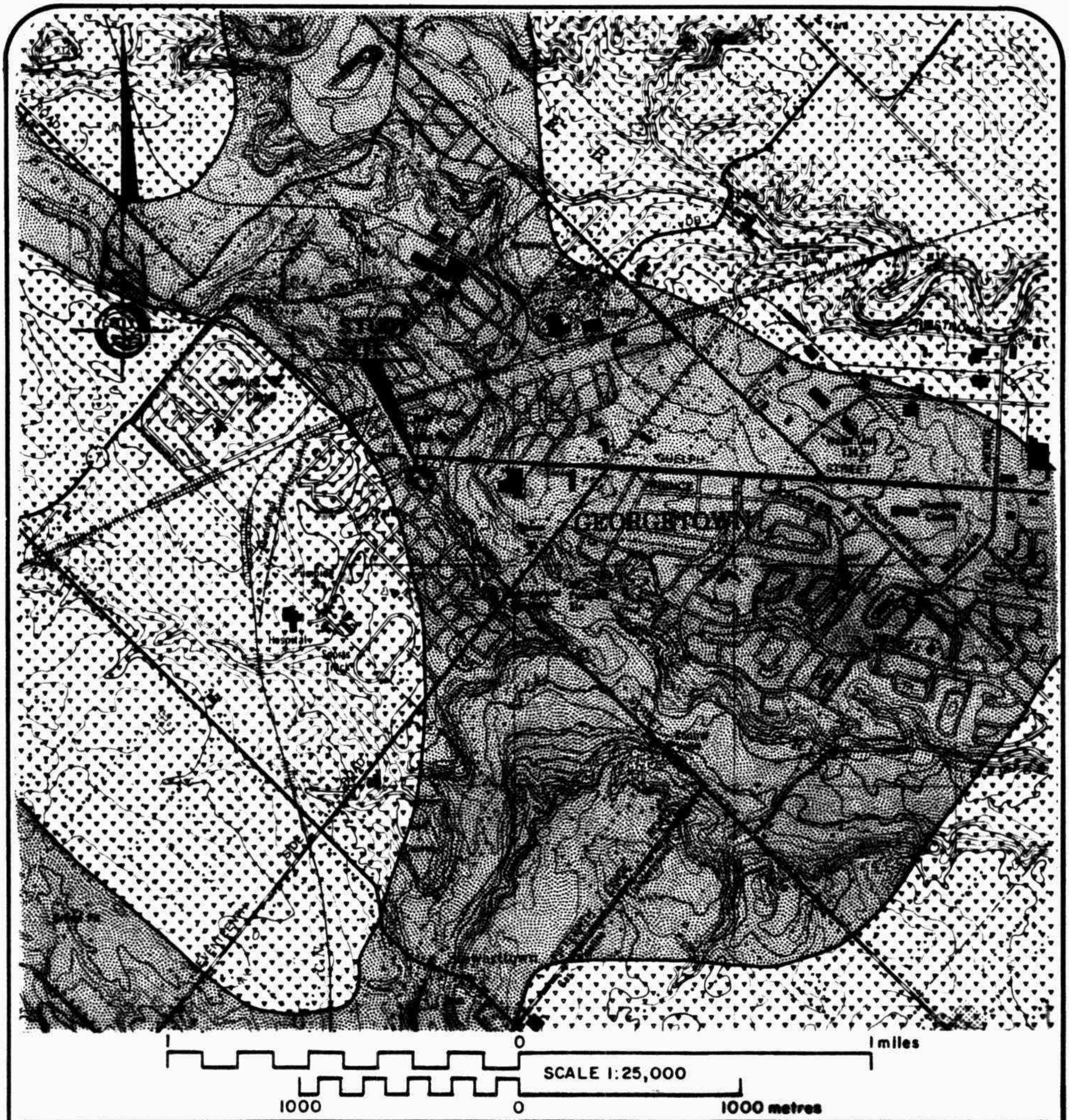
Test drilling at the site encountered reddish-brown, medium to coarse grained sand on the banks of the former ravine and beneath the landfill refuse at most of the borehole locations.

The site is within the watershed of the Georgetown Branch of the Credit River. This river flows southward about 200 m east of the disposal area. Manholes in the site transport surface runoff to the storm sewers.

Groundwater flow is towards the east following the former ravine. The storm sewer and lack of infiltration caused by the asphalt cover, depress the water table in this area. The water table is between 9.5 and 11 m below surface.

4.2.3 Disposal Site Detail

The landfill site has been completely capped with asphalt pavement. The surface slopes downward to the southeast. The paved surface is undulating due to uneven settlement of the landfill beneath. The parking lot was also reported to have "caved-in" on a number of occasions.



LEGEND

▨ SAND

⁘ TILL

Source: Chapman, L.J. & Putnam, D.F. 1972

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7060 GEORGETOWN

GEOLOGY

PROJECT NO. 262-811

APR. 1983

morrison beatty limited
consulting engineers and hydrogeologists

B3

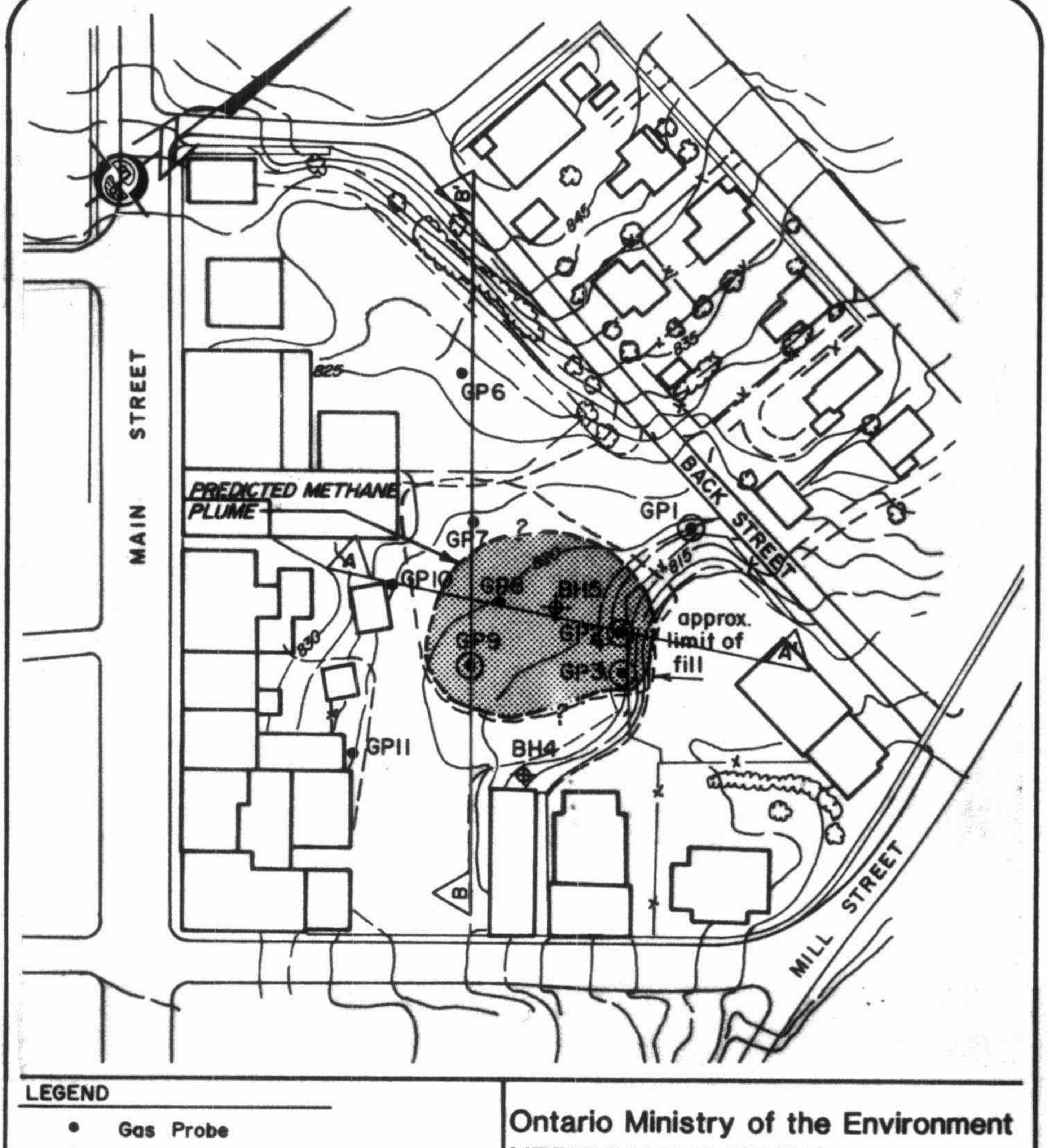
The fill material is similar to the refuse found at the East York site. It consists mainly of ash, cinders, and other well decomposed material. Test drilling showed the landfill depth ranges from shallow (2.2 m) near the original ravine bank to over 8.0 m deep near the centre line of the old ravine (GP 3). The borehole logs are found in the Technical Data Catalogue, Section C, 1.0.

4.2.4 Identified Impacts

Site instrumentation at this site consists of 9 gas probe locations, one gas pumping well and four groundwater observation wells. Two of the gas probe locations consist of single foundation probes. The remainder are probe nests with one shallow and one deep probe. All gas probes and observation well details are outlined in the borehole logs (Section C, 1.0 of the Technical Data Catalogue). Gas probe locations are shown on Figure B-4 and all observation wells are shown on Figure B-5. The landfill site, buildings, and their location relative to the monitors are shown on Figures B-6 and B-7.

Methane was detected only within the disposal area. Concentrations ranged from 0 to 32% in the shallow probes and from 0 to 35% in the deep probes at GP 8 and GP 9. These probes are located in the deepest part of the refuse and consistently showed the highest concentrations of methane.

Small concentrations of methane were recorded in GP 3 (deep) and GP 2 (shallow) on several occasions. These two probes are also located within the refuse material. No methane was recorded in probes outside the fill limits.



LEGEND

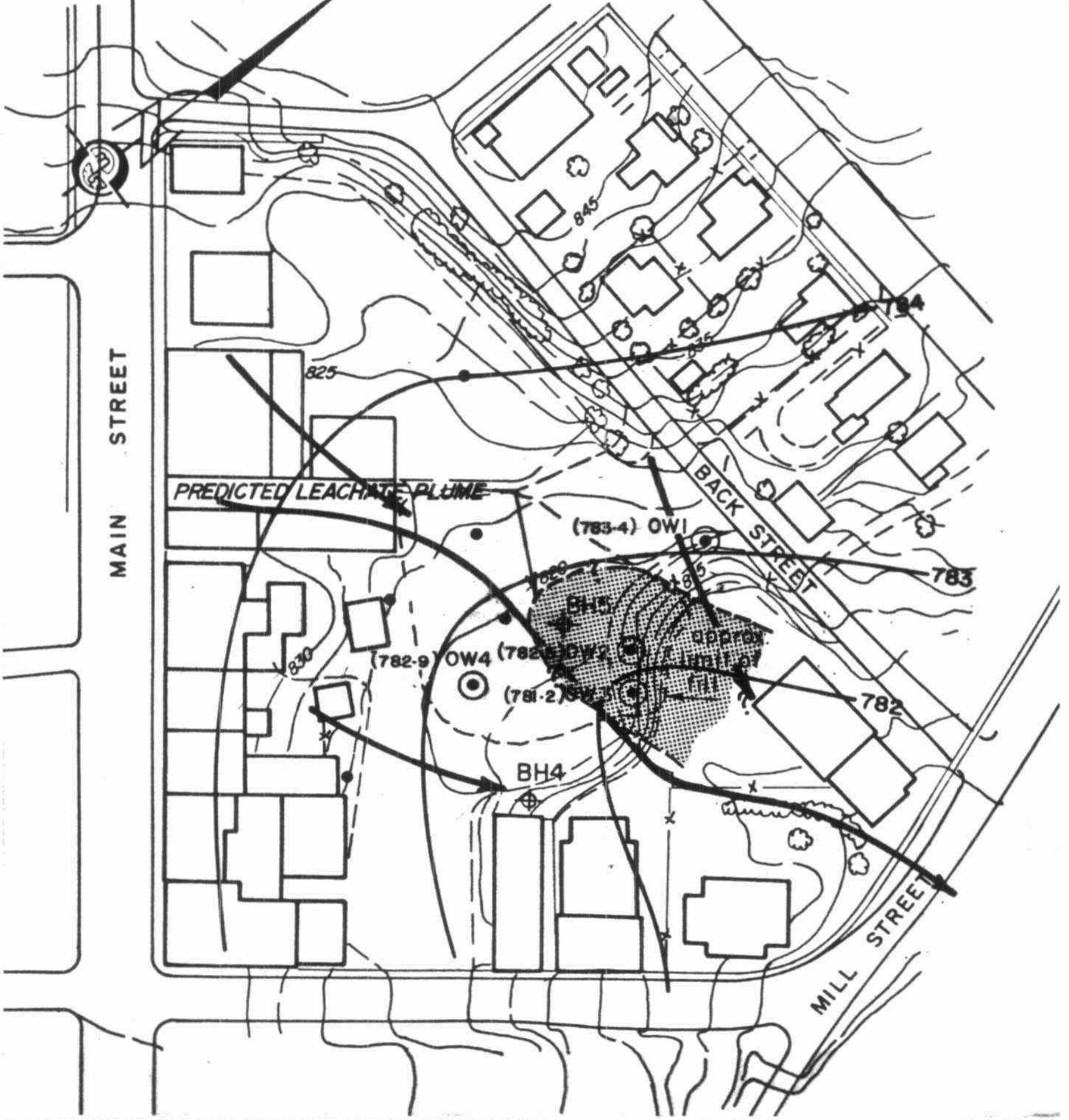
●	Gas Probe
⌖	Borehole
○	Observation Well
2.5'	Contour Interval
△A	Cross-Section Location

30 0 30 60 m
SCALE 1:1200

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7060 GEORGETOWN

GAS PROBE LOCATION PLAN

PROJECT NO. 262-811	APRIL, 1983
morrison beatty limited consulting engineers and hydrogeologists	B4



LEGEND

●	Gas Probe
⌖	Borehole
○	Observation Well
2.5'	Contour Interval
—	Groundwater Contour
➞	Flow Arrow

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7060 GEORGETOWN

OBSERVATION WELLS ; WATER TABLE

PROJECT NO. 262 - 811

APRIL, 1983

morrison beatty limited
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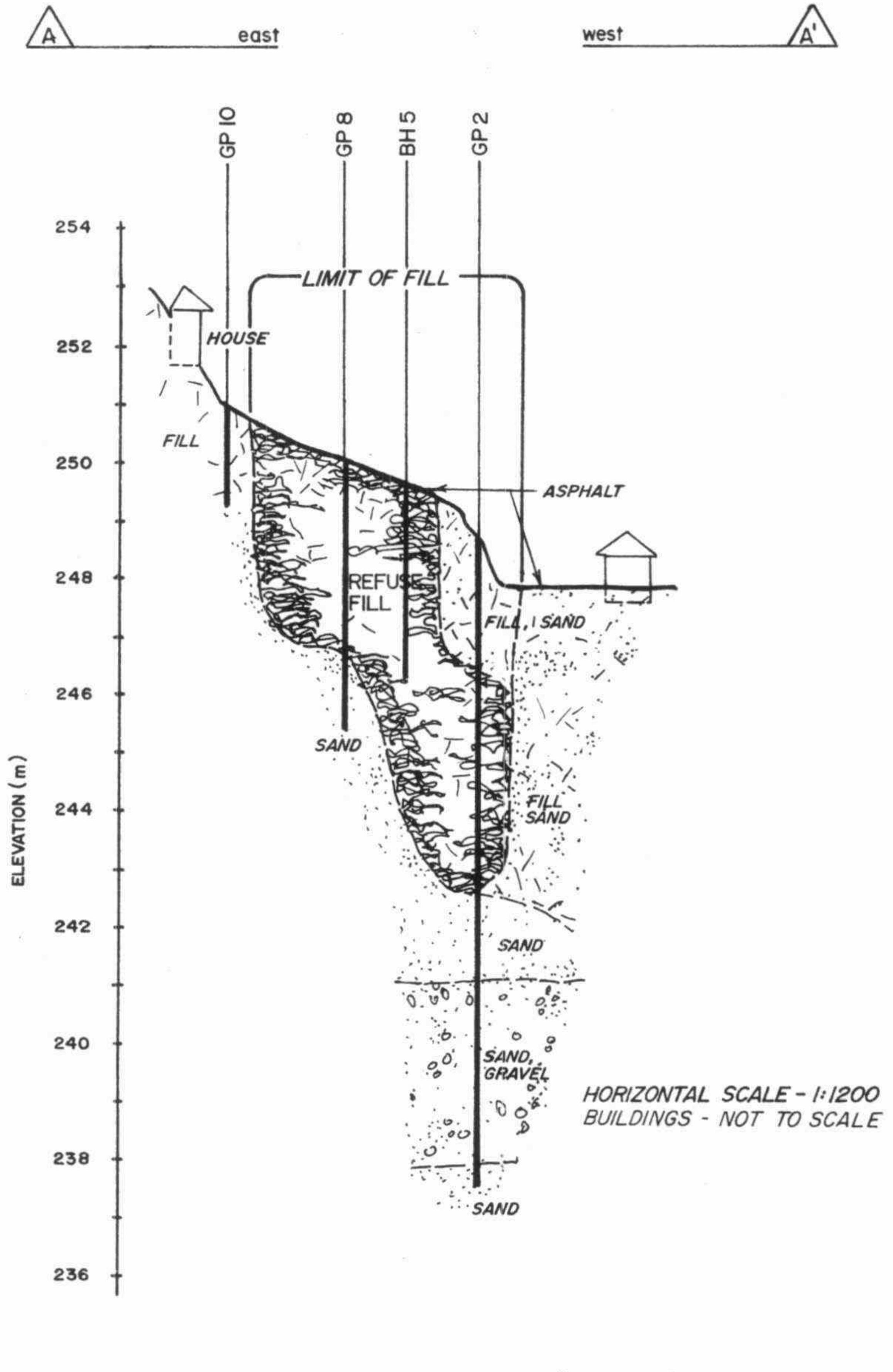
B5



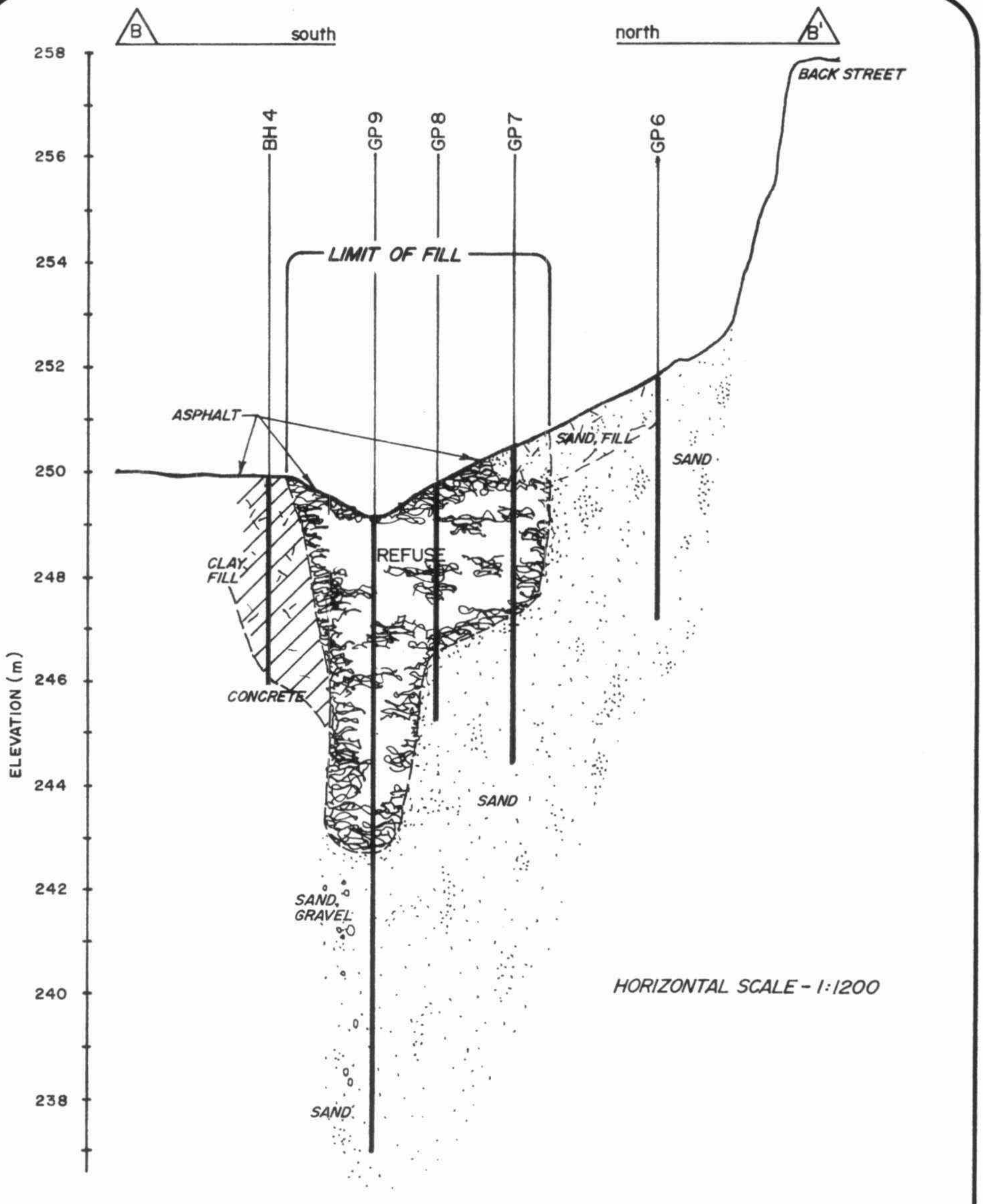
HORIZONTAL SCALE - 1:1200
BUILDINGS - NOT TO SCALE

CROSS SECTION A - A'

MINISTRY OF THE ENVIRONMENT
Verification Study Project No. 262-811
Site: No. 7060, Georgetown

morrison beatty limited
consulting engineers and hydrogeologists

B6



CROSS SECTION B-B'

MINISTRY OF THE ENVIRONMENT
Verification Study Project No. 262-811
Site: No. 7060, Georgetown

morrison beatty limited
consulting engineers and hydrogeologists

B7

Soil pressure readings were recorded throughout the monitoring program. As with the East York site, pressure differentials were slight. Pressures ranged from -0.07 to +0.08 inches of water. Negative pressures occured on most monitoring dates. Attempts were made to correlate the changes in pressure to the methane concentrations and extent of migration. No patterns are obvious.

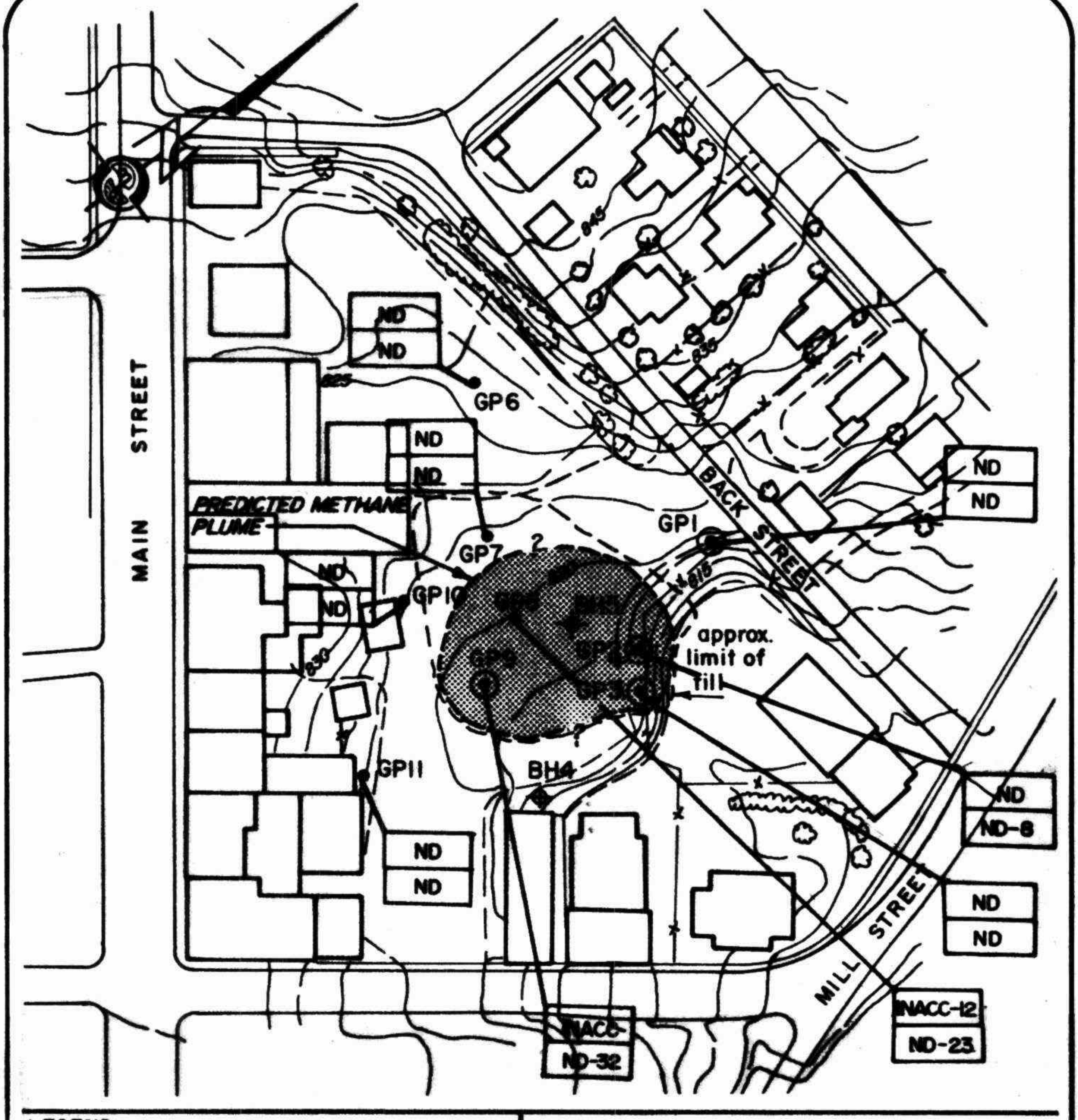
The occurrence of precipitation events at the site and the impact on methane concentrations were studied using Environment Canada's daily records. (Section A, 3.0 of the Technical Data Catalogue). Again no patterns became obvious.

Tables of all methane and pressure readings are included in Section C, 2.0 of the Technical Data Catalogue. Ranges of readings at each probe and the predicted methane plume are shown on Figures B-8 and B-9. A graph summarizing this information is shown on Figure B-10.

The site receives very little or no infiltration and the water table is situated below the refuse material. Therefore, a very small amount of leachate is generated. The strength of leachate will also weaken with time. Groundwater quality and the predicted leachate plume is shown on Figure B-11.

4.2.5 Gas Pumping Test

A pumping test was conducted at the Georgetown site on October 19, 1981. The pumping well (GP 2-d) is located at the edge of the paved parking area as shown on Figure B4. The well is about 4.5 m deep. The construction details are shown in Section A of the Technical Data Catalogue.



LEGEND

- ● Gas Probe
- ✦ Borehole
- ○ Observation Well
- 2.5' Contour Interval

SCALE
1:1200

SHALLOW PROBES

Range in methane concentration:
- frozen ground (% volume)
- unfrozen ground (% volume)

ND not detected
INACC inaccessable

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7060 GEORGETOWN

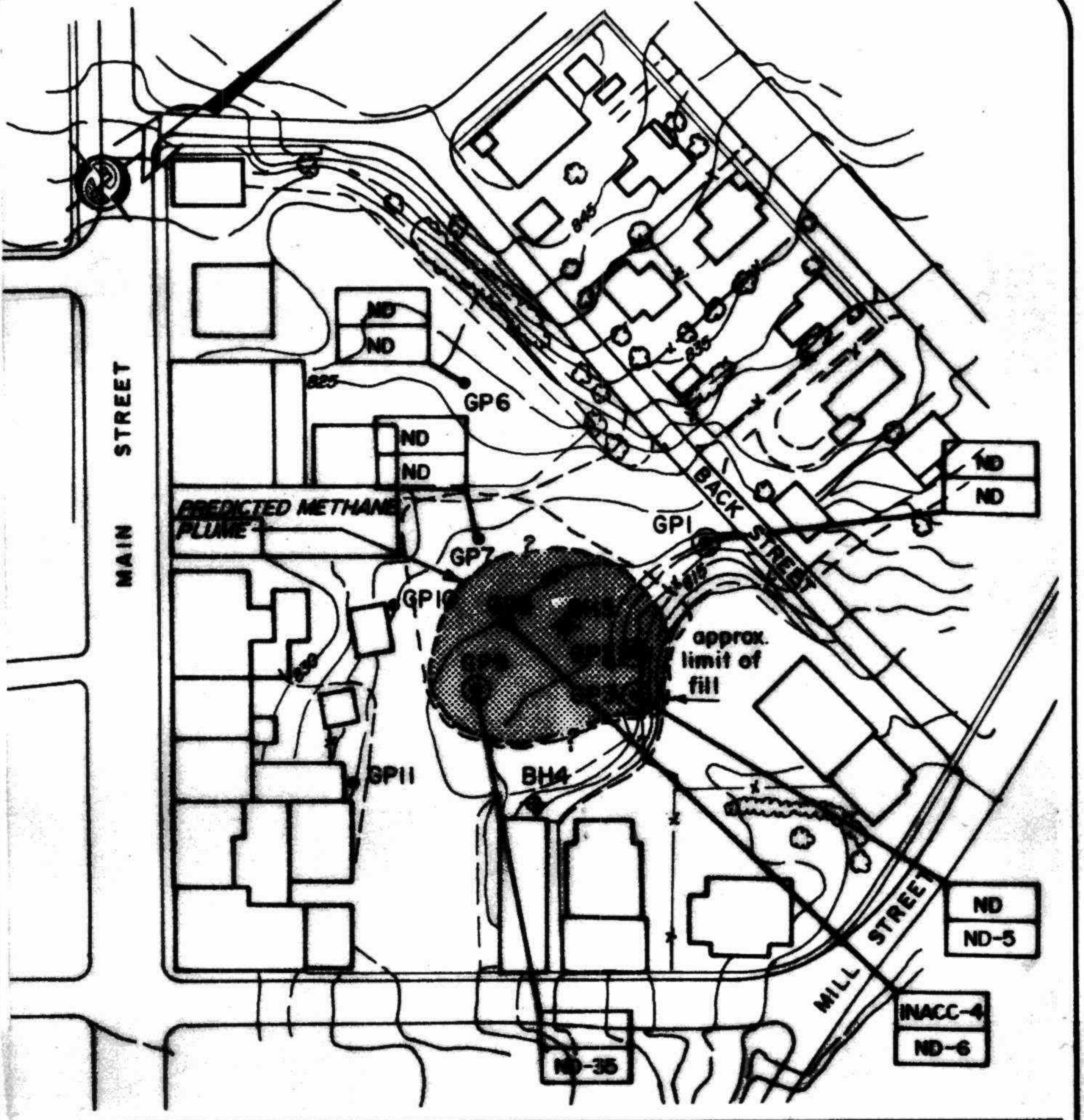
METHANE CONCENTRATION - SHALLOW PROBES

PROJECT NO. 262-811

APRIL, 1983

morrison beatty limited
consulting engineers and hydrogeologists

B8



LEGEND

- ● Gas Probe
- ✦ Borehole
- ○ Observation Well

2.5' Contour Interval

DEEP PROBES

Range in methane concentration:
- frozen ground
- unfrozen ground

ND	not detected
INACC	inaccessable

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7060 GEORGETOWN

METHANE CONCENTRATIONS - DEEP PROBES

PROJECT NO. 262-811

APRIL, 1983

morrison beatty limited
consulting engineers and hydrogeologists

B9

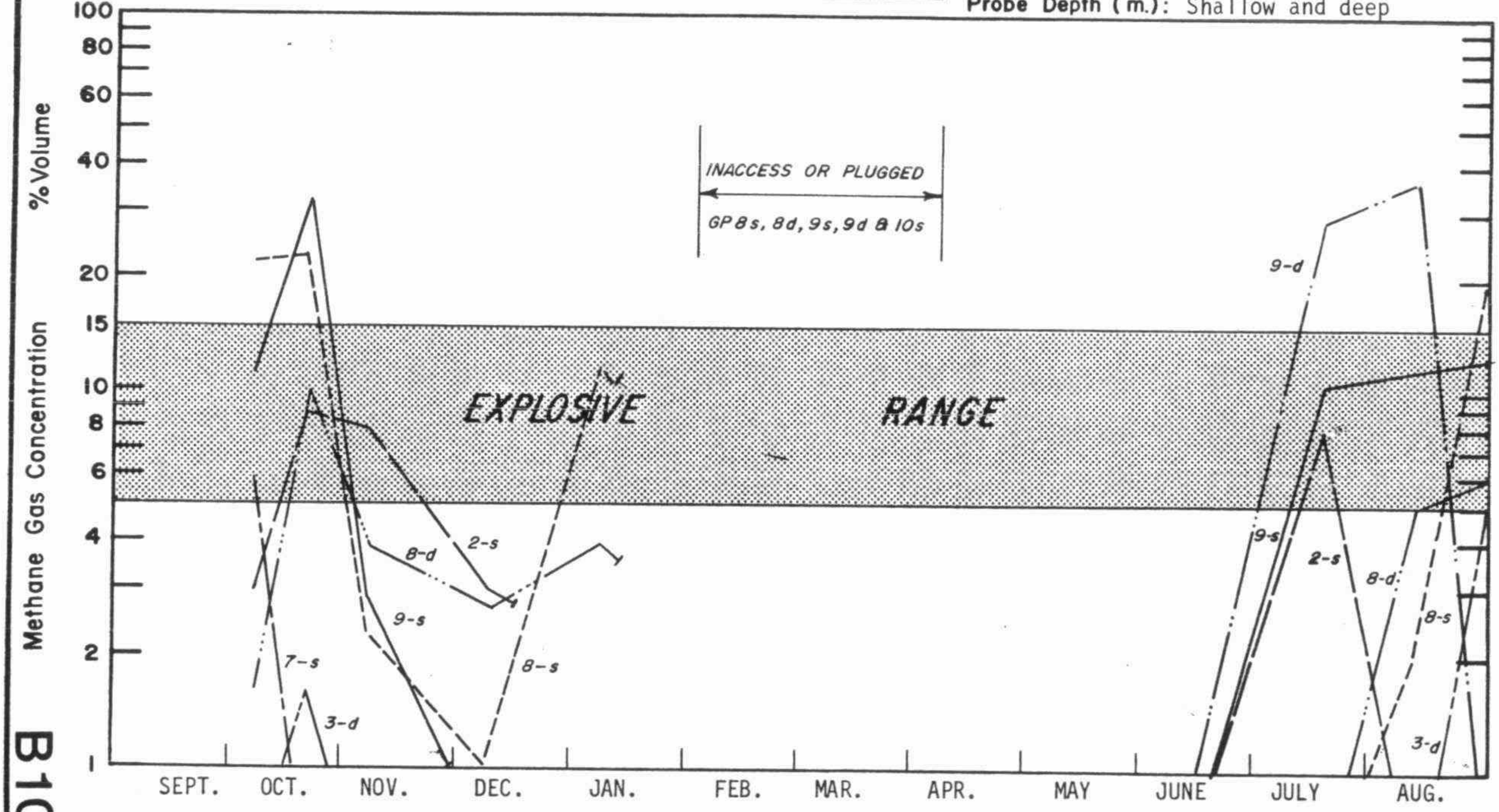
L6-090681

morrison beatty limited
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

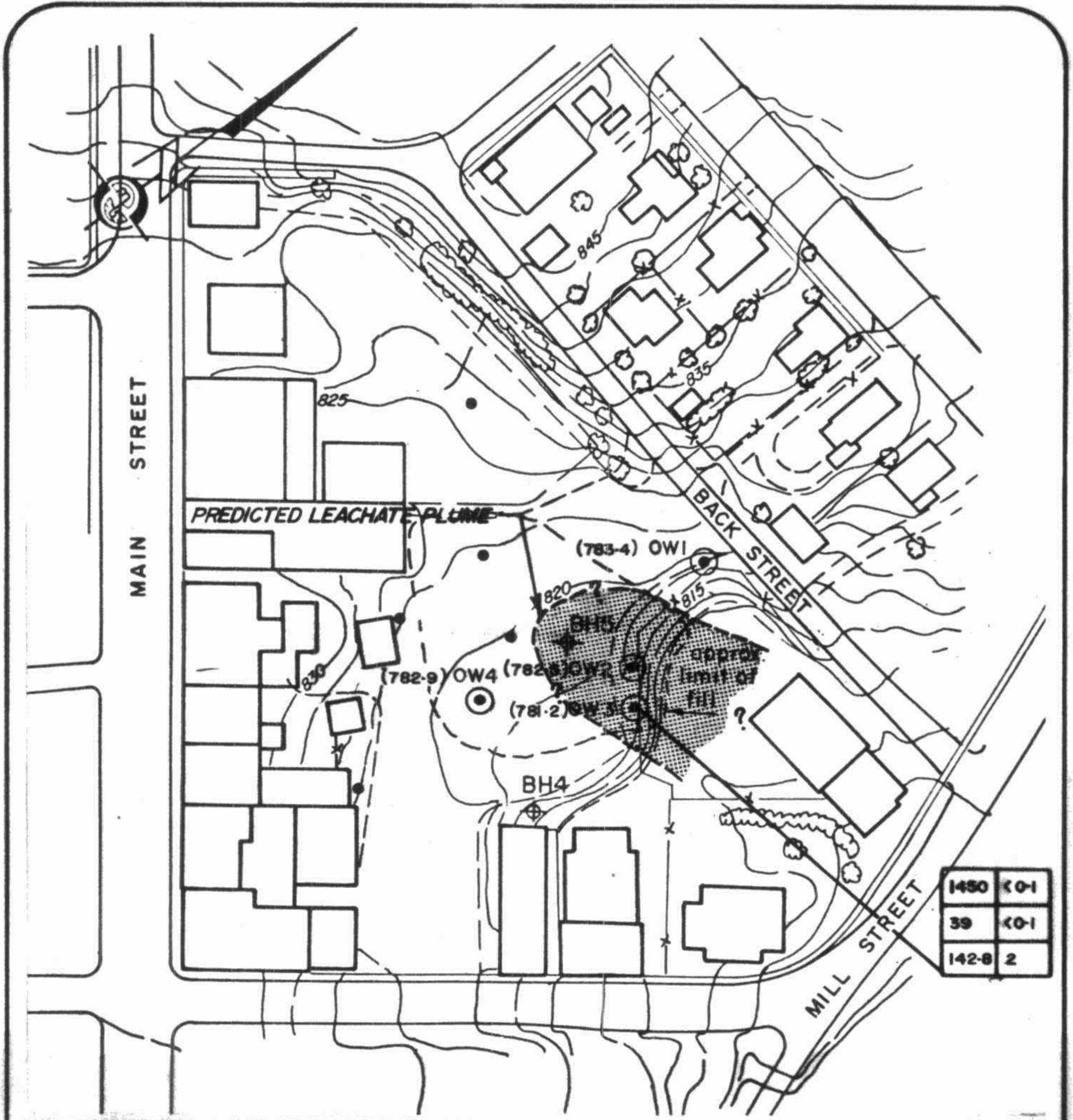
Methane Gas Probe Data

B10

Client Ministry of the Environment
Job No. 262-811
Gas Probe No. GP 2 to GP 11
Landfill location Georgetown
Recorder
Probe location: refuse ☐ soil ☐
Probe Depth (m.): Shallow and deep



Time Interval in months



LEGEND

- ● Gas Probe
- ⌖ Borehole
- ○ Observation Well
- 2.5' Contour Interval

Conductivity	*Cond.	NH_4	Free Ammonia
Chlorides	Cl	P	Total Phosphorous
Sulphates	SO_4	TOC	Total Organic Carbon

Concentrations in mg/l except as noted * umhos/cm

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7060 GEORGETOWN

GROUNDWATER QUALITY

PROJECT NO. 262 - 811

APRIL, 1983

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consulting engineers and hydrogeologists

B11

The well was pumped at a rate of 10 cc/s or 16 cfm for 60 minutes. Methane concentrations in the shallow probes remained relatively constant throughout the test. This is probably due to the paved surface which does not allow air recharge from the surface. Towards the end of the test there was a slight reduction in methane readings in the deeper probes.

Graphs showing pressure change over time, percentage methane over time, and pressure drawdown are shown on Figures B-12 and B-13. Graphs are included for both the shallow and the deep probes.

4.2.6 Potential Impacts

The permeable sand and gravel, the paved surface and the proximity to development suggests this site could generate a methane impact; however, the composition and age of the waste material and the limited infiltration into the waste minimizes the volume of methane produced. Methane was found only within the refuse material during the twelve month monitoring period. Impacts on the surrounding buildings due to methane are not expected. Similarily, we do not anticipate any detrimental impacts from leachate generated at this site.

morrison beatty limited
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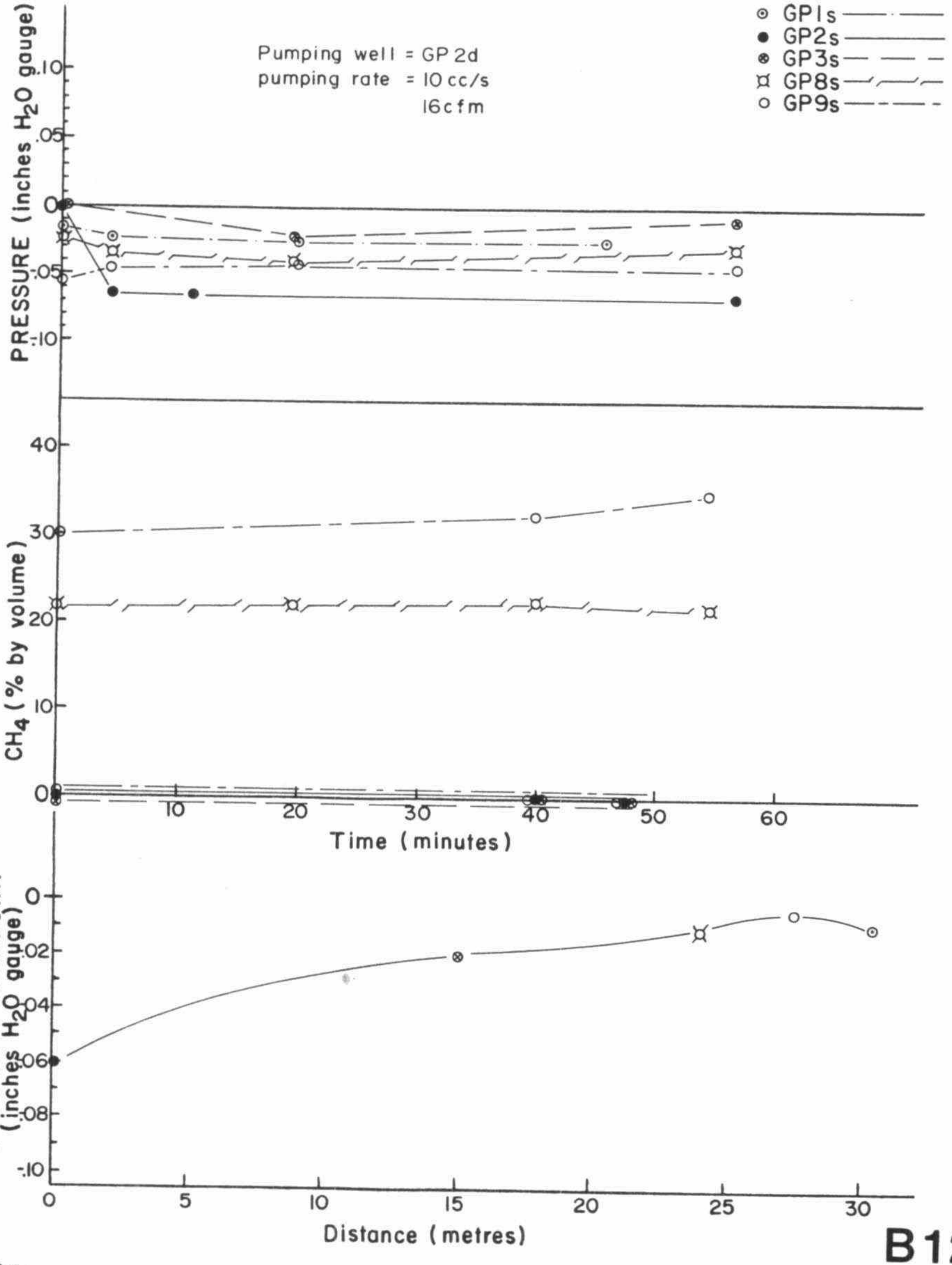
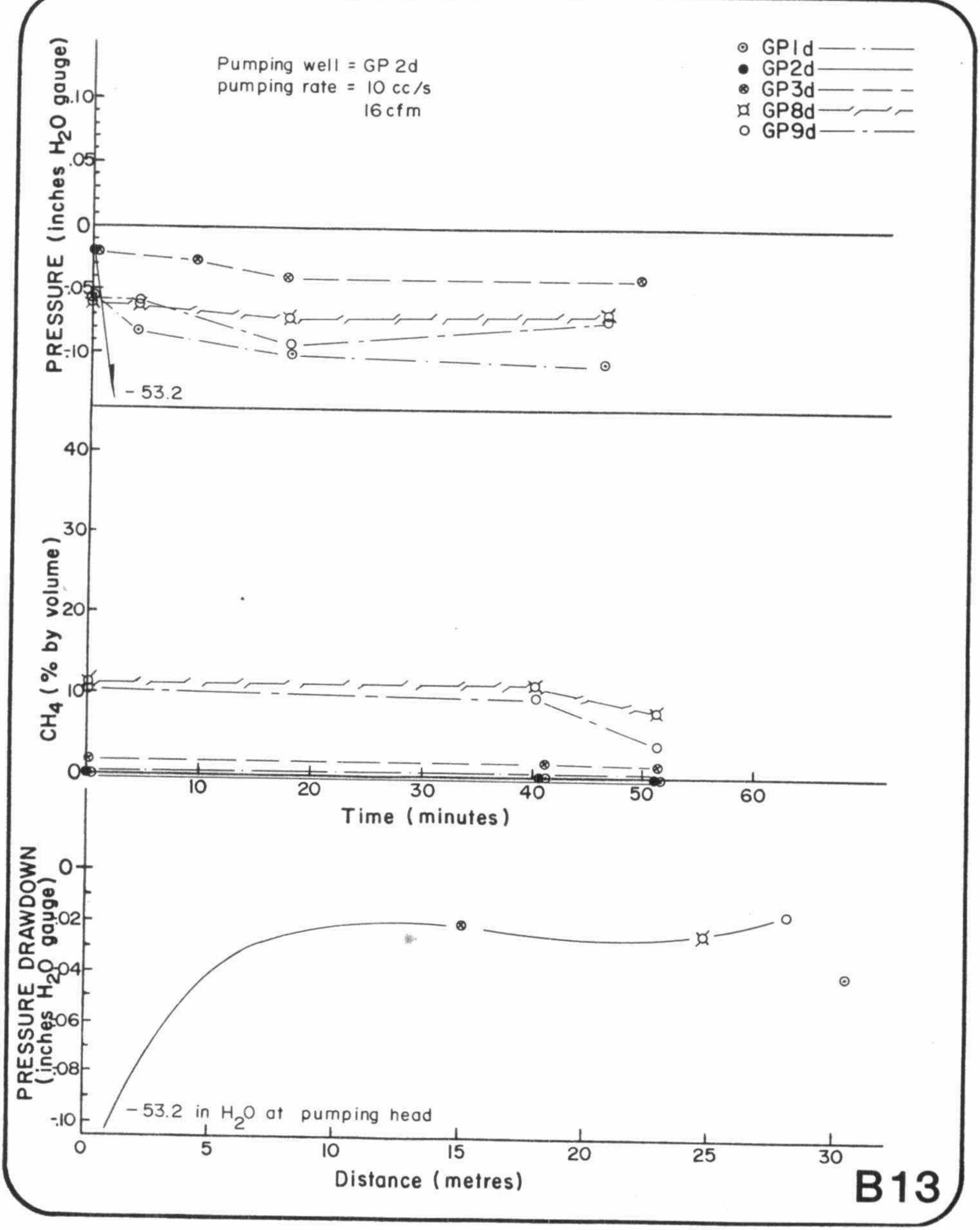
GAS PUMPING TEST
M.O.E. VERIFICATION STUDY
SITE NO. 7060, Georgetown
(shallow probes ∽1.5 m)



B12

morrison beatty limited
consulting engineers and hydrogeologists

GAS PUMPING TEST
M.O.E. VERIFICATION STUDY
SITE NO. 7060, Georgetown
(deep probes ∼ 4.5 m)



B13

4.2.7 Recommendations

The verification study has confirmed the conclusions drawn from the preliminary study. This site remains in the "no hazard risk" category.

It is our recommendation that:

1. Determine a method by which the "limits of fill" and the requirements for methane controls can be permanently recorded in public records.
2. No further studies be required at this site.

4.2.8 Comparison of Results

The results of the Verification Study are compared to the preliminary study results in the following chart:

TASK	STUDY RESULTS Preliminary Study	 Verification Study
1. Identify Leachate Seeps	- none	- none
2. Identify Vegetation Stress	- none	- none
3. Hydrology & Drainage Characteristics	- stream to east of site approximately 200 m - site drained by storm sewers - site was a former ravine	- Credit River watershed - same as preliminary study
4. Local Geology	- glacial meltwater spillway material - mainly sand and gravel	- same as preliminary study
5. Limits of Fill	- most of parking lot area - depth unknown	- fill limits determined through test drilling - consists of a smaller area than thought - depth of fill approx. 8-9 m
6. Composition of Fill	- domestic waste	- mainly ash and well decomposed deomestic waste
7. Type of Cover	- asphalt - material below asphalt unknown	- asphalt with sandy fill below - over one metre of sandy fill over refuse
8. Hydrogeologic Characteristics	- groundwater flow anticipated to be to the east - depth to water table unknown	- groundwater flow to east confirmed - water table between 9-10 m below surface
9. Volume of Waste	- unknown	- estimated from test drilling at 10,000 m^3

10. Leachate Quality and Quantity	- leachate expected to be of little hazard - specific leachate characteristics unknown	- leachate confirmed to pose no hazard - quality tabulated in Section C, 3.0 of Technical Data Catalogue
11. Methane Concentrations	- no methane detected at this site	- methane detected in several gas probes within the disposal refuse (0-35%) - no methane found off site at any time
12. Methane Seepage into Buildings	- none anticipated	- no methane found outside of disposal area - none found in foundation probes
13. Identified Impacts	- none due to age of site	- none - methane is produced but does not migrate - no leachate impact
14. Potential Impacts	- none	- none
15. Remedial Recommendations	- no further study required	- no further study required - no remedial work necessary

The Verification Study tends to clarify some unknown characteristics at this site but the final results were the same. Although the site had some characteristics which may have caused a problem, such as reduced venting by the asphalt cover and the proximity to buildings, the age and composition of waste limited the impacts. Methane is still being produced at this site but is not migrating away from it. The preliminary study failed to determine the presence of methane but recognized the probability that no hazard existed at the site.

The Verification Study determined the fill limits so that they can be identified in public records as an area where building should be restricted. This recommendation, also given in the preliminary study, is still valid since methane exists within the fill limits.

4.3 Mississauga, Site No. 7071

4.3.1 Background

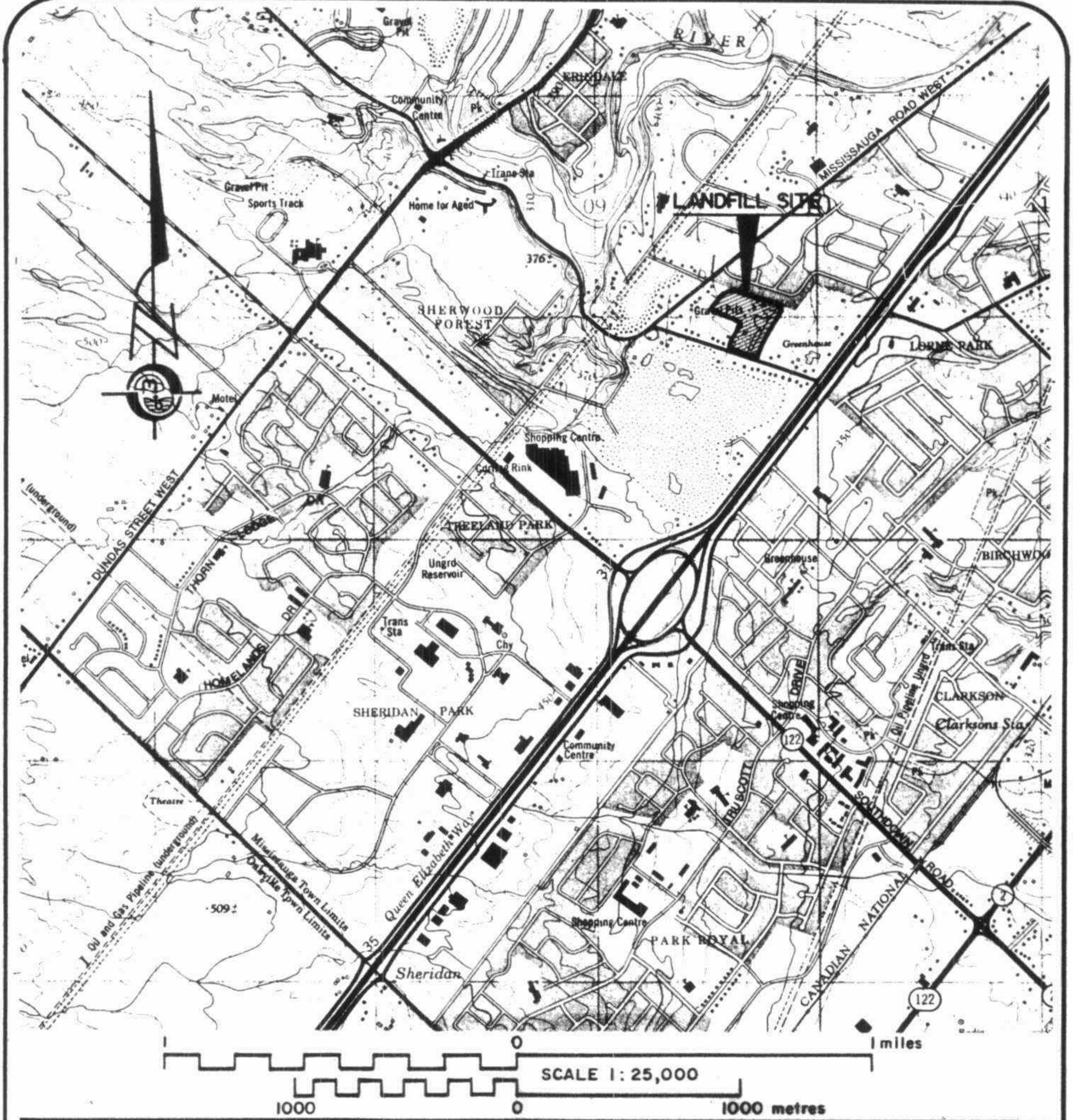
This site is located in the City of Mississauga between Dundas Street West and the Queen Elizabeth Way. Springbank Drive borders the site to the south; Mississauga Road is located about 100 m to the northwest; and the houses on Portway Drive back onto the site to the northeast. The lcoation within the City of Mississauga is shown on the regional topographic map, Figure C-1.

The disposal area was a former sand and gravel pit. It was then used as a domestic disposal area for the City of Mississauga and a fly ash disposal area for Ontario Hydro in the 1960's. The fly ash is limited to the northwestern portion of the former pit and was from Hydro's Lakeview Generating Station.

The portion of the site which was filled with fly ash (about one third of the total area) is now a park and a parking lot. The remaining area (two thirds of total) is a vacant grassed field. The surrounding land uses are mainly residential with some vacant land and an orchard abutting the site to the east. The large Mississauga landfill site is located on the opposite side of Springbank Drive. All surrounding land uses are shown on the enlarged aerial photograph, Figure C-2.

4.3.2 Hydrogeologic Setting

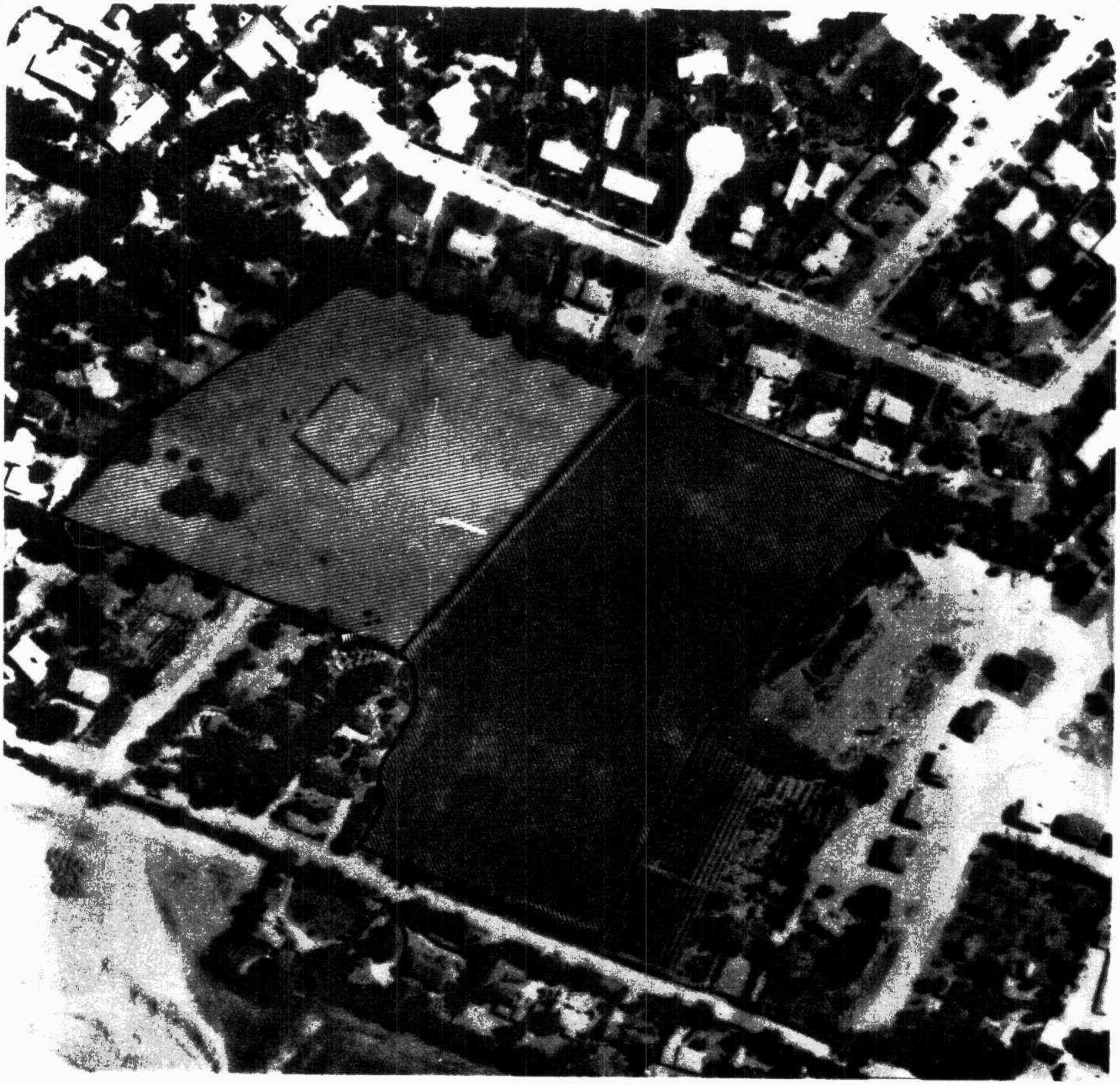
The Mississauga site is within the Iroquois sand plain which parallels the present Lake Ontario shoreline. The sand deposit marks the shoreline of post-glacial Lake Iroquois. Local geology is shown on Figure C-3.



Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7071 MISSISSAUGA

TOPOGRAPHIC LOCATION

PROJECT NO. 262-811	MAR. 1983
morrison beatty limited consulting engineers and hydrogeologists	C1

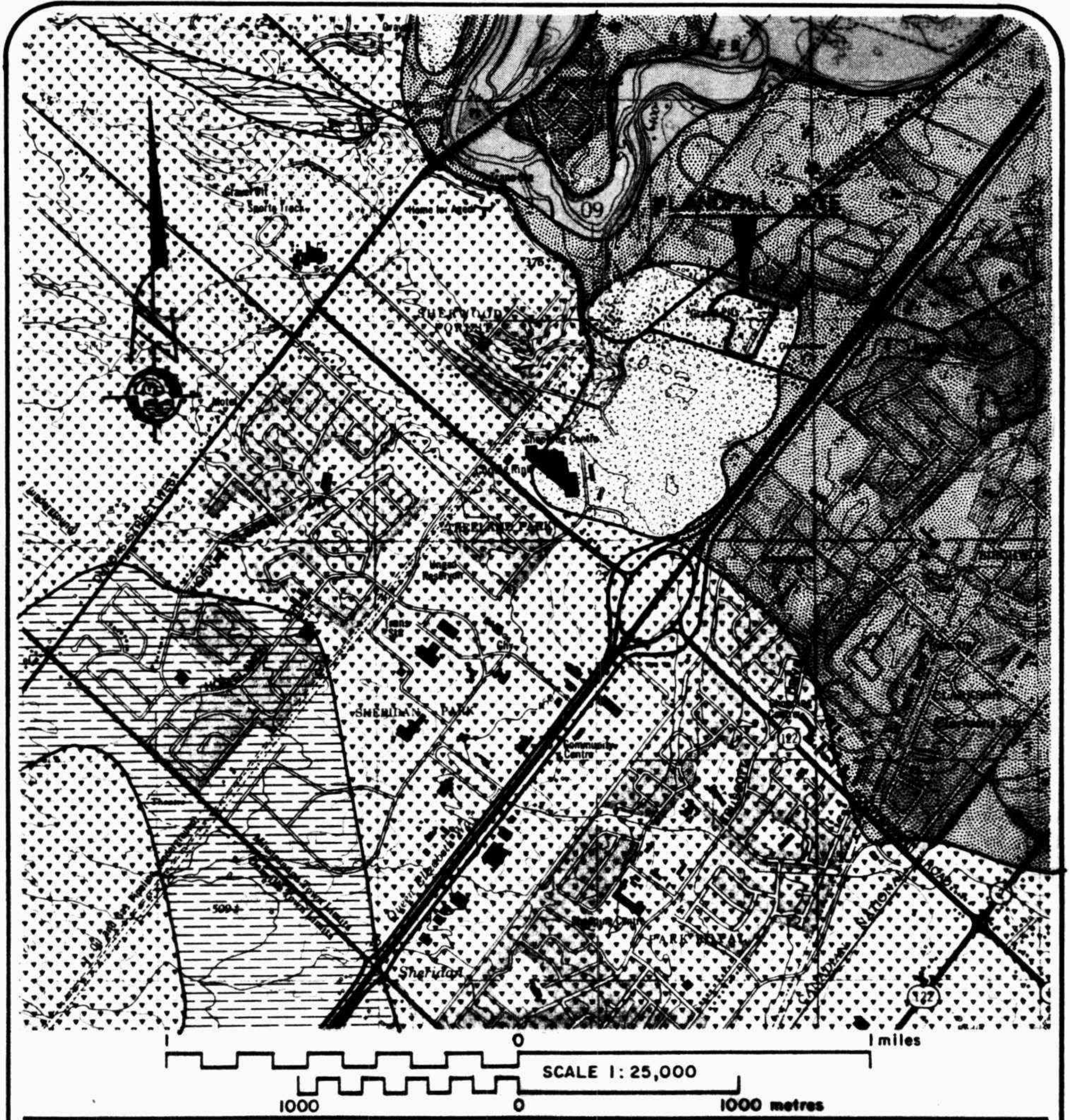


▨ LANDFILL BOUNDARY

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7071 MISSISSAUGA

AIR PHOTO LOCATION

PROJECT NO. 262-811	MAR. 1983
morrison beatty limited consulting engineers and hydrogeologists	C2



LEGEND

- ▩ SAND
- ▿ TILL
- ░ SAND & GRAVEL
- ▓ ALLUVIUM
- ☰ SHALE

Source: Sharpe, D.R. 1980

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7071 MISSISSAUGA

GEOLOGY

PROJECT NO. 262-811	MAR. 1983
morrison beatty limited consulting engineers and hydrogeologists	C3

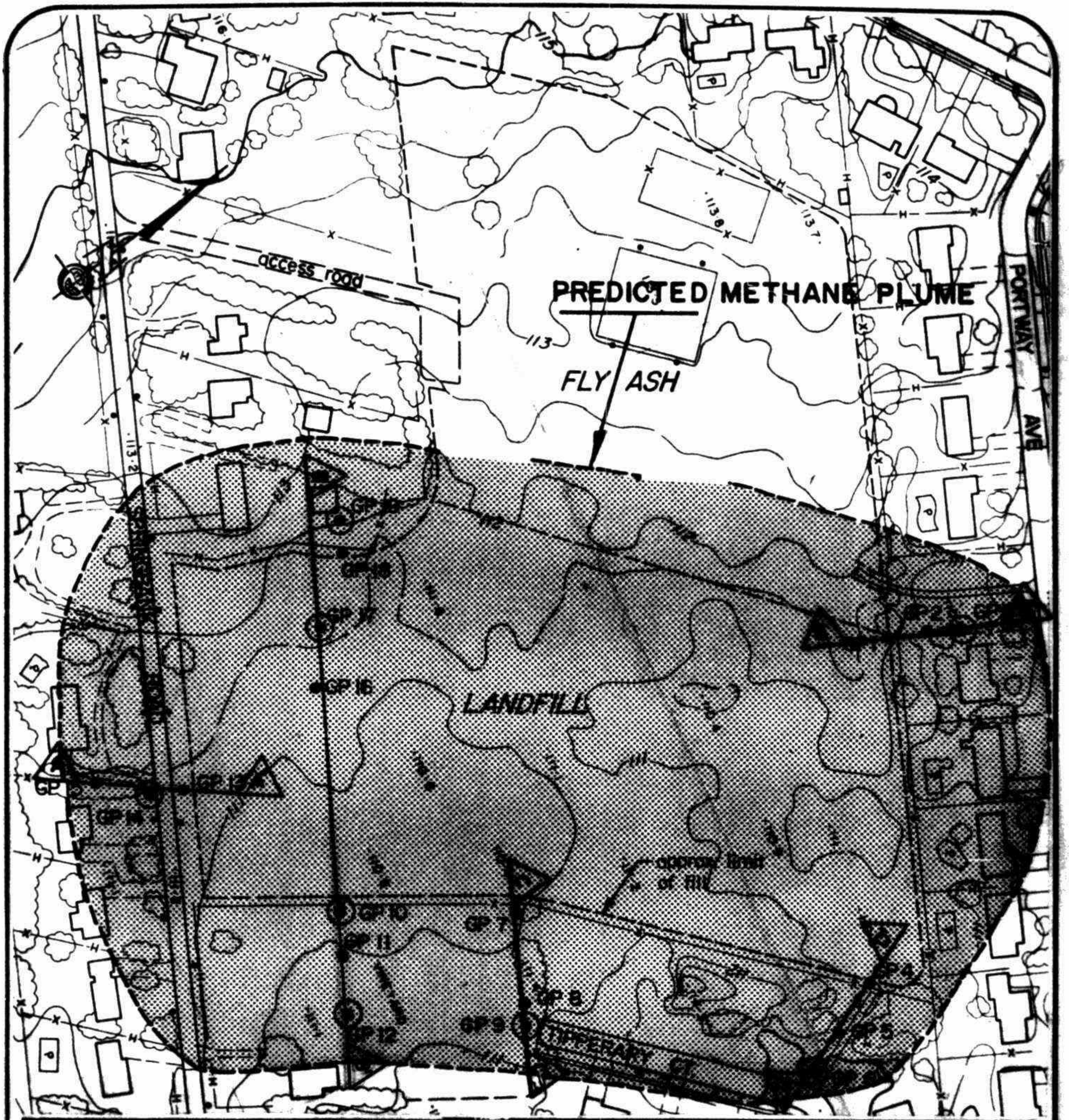
The sand and gravel deposits at the site were laid down in the form of a barrier beach where a river emptied into Lake Iroquois. The deposits were laid down in moderately fast moving water and contain very little silt or clay material. The test drilling confirmed the stratigraphy of medium to coarse grained sand with lenses of sand and gravel.

Regionally, surface drainage is towards the Credit River. Drainage is good due to the permeable sand and gravel deposits. Groundwater flow is generally southward as shown on Figure C-5. The water table is approximately 9 m below surface. All water levels are listed in Section D, 4.0 of the Technical Data Catalogue.

4.3.3 Disposal Site Detail

The disposal site is in an abandoned sand and gravel pit. The filled area takes the shape and depth of the worked out area. The limits of fill were easily identified by differential settlement cracks around the perimeter of the old pit. The drilling program was therefore aimed at determining surrounding geology and optimum positioning of gas monitoring probes. The fill limits are shown on Figure C-4.

The depth of fill is approximately 9.0 m indicating that the sand and gravel was excavated to the water table. Sand and gravel was also encountered below the landfill refuse at 8.7 m in GP 16. All borehole logs are found in Section D, 1.0 of the Technical Data Catalogue.



LEGEND

- ● Gas Probe
- ⊕ Borehole
- ○ Observation Well
- △ B Cross-section Location

Metres 100 0 SCALE 1:2000

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7071 MISSISSAUGA

GAS PROBE LOCATION PLAN

PROJECT NO. 262-811

APRIL, 1983

morrison beatty limited
consulting engineers and hydrogeologists

C4

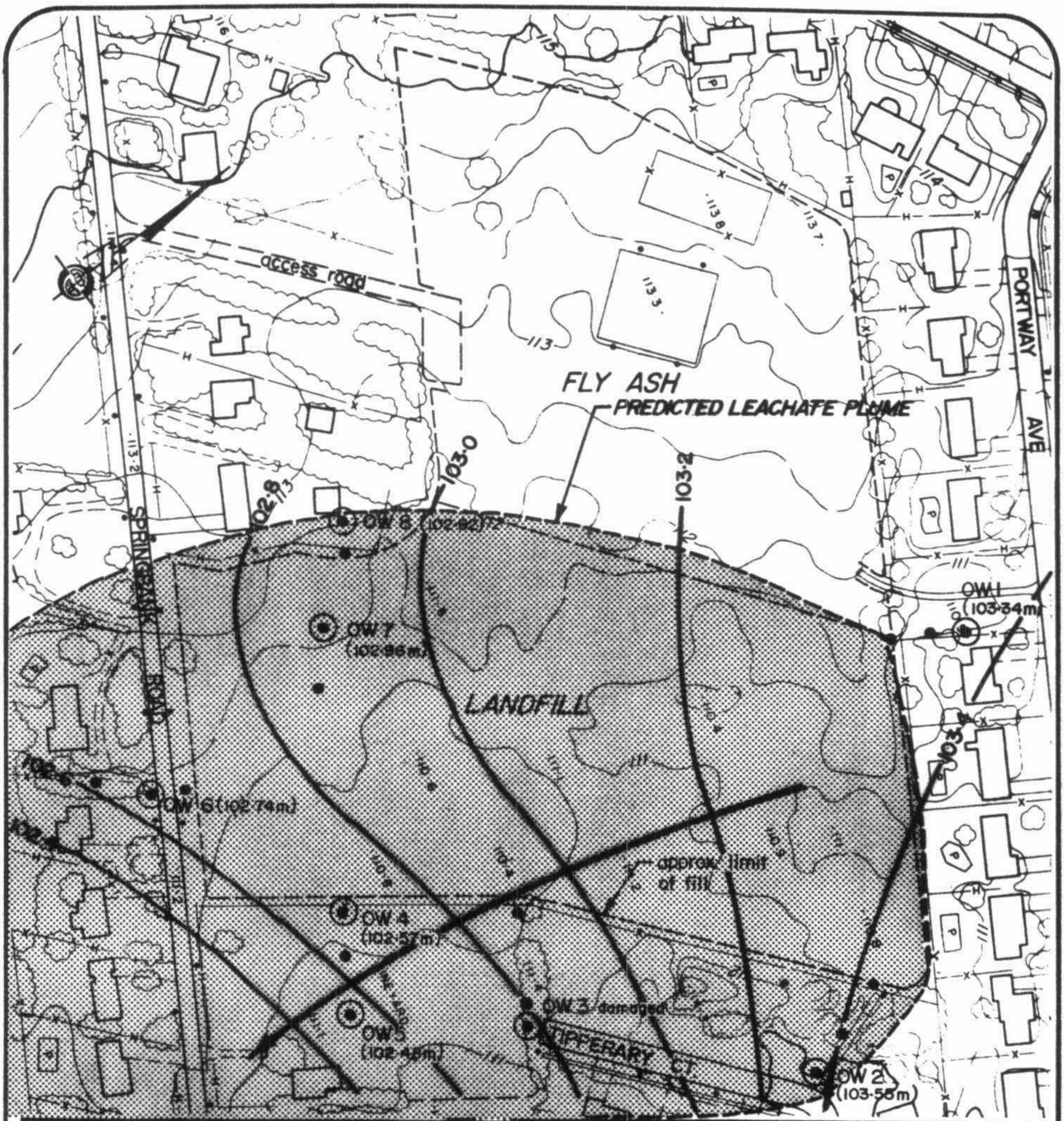
The disposal area was filled to grade and covered with a sandy clay material. The cover material is about one metre thick. Decomposition of the refuse has caused extensive settlement, lowering the site topography up to one metre below the surrounding ground surface. The cross-sections, Figures C-6 to C-9 show the disposal area details, site topography and borehole locations.

4.3.4 Identified Impacts

Instrumentation at this site consists of 19 gas probe nests (one shallow and one deep), one gas pumping well (in the refuse) and eight groundwater observation wells. These were installed in the landfill and in radiating lines from the fill area. All gas probe and observation well details are outlined on the borehole logs (Section D, 1.0 of the Technical Data Catalogue). Gas probe locations are shown on Figure C-4 and observation wells are shown on Figure C-5.

Methane

The proximity of residential areas and the permeable nature of the local sand and gravel deposits make this site a potential hazard with regard to off-site methane migration. Methane related vegetation stress was noted on the site and adjacent to it in the vineyard. Settlement cracks were identified around the perimeter of the site. The cross-sections (Figures C-6 to C-9) show the residences' foundations in relation to the landfill site and gas probe installations.



LEGEND

- ● Gas Probe
- ⌖ Borehole
- ○ Observation Well
- — Groundwater Contour
- → Flow Arrow

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7071 MISSISSAUGA

OBSERVATION WELLS; WATER TABLES

PROJECT NO. 262-811

APRIL, 1983

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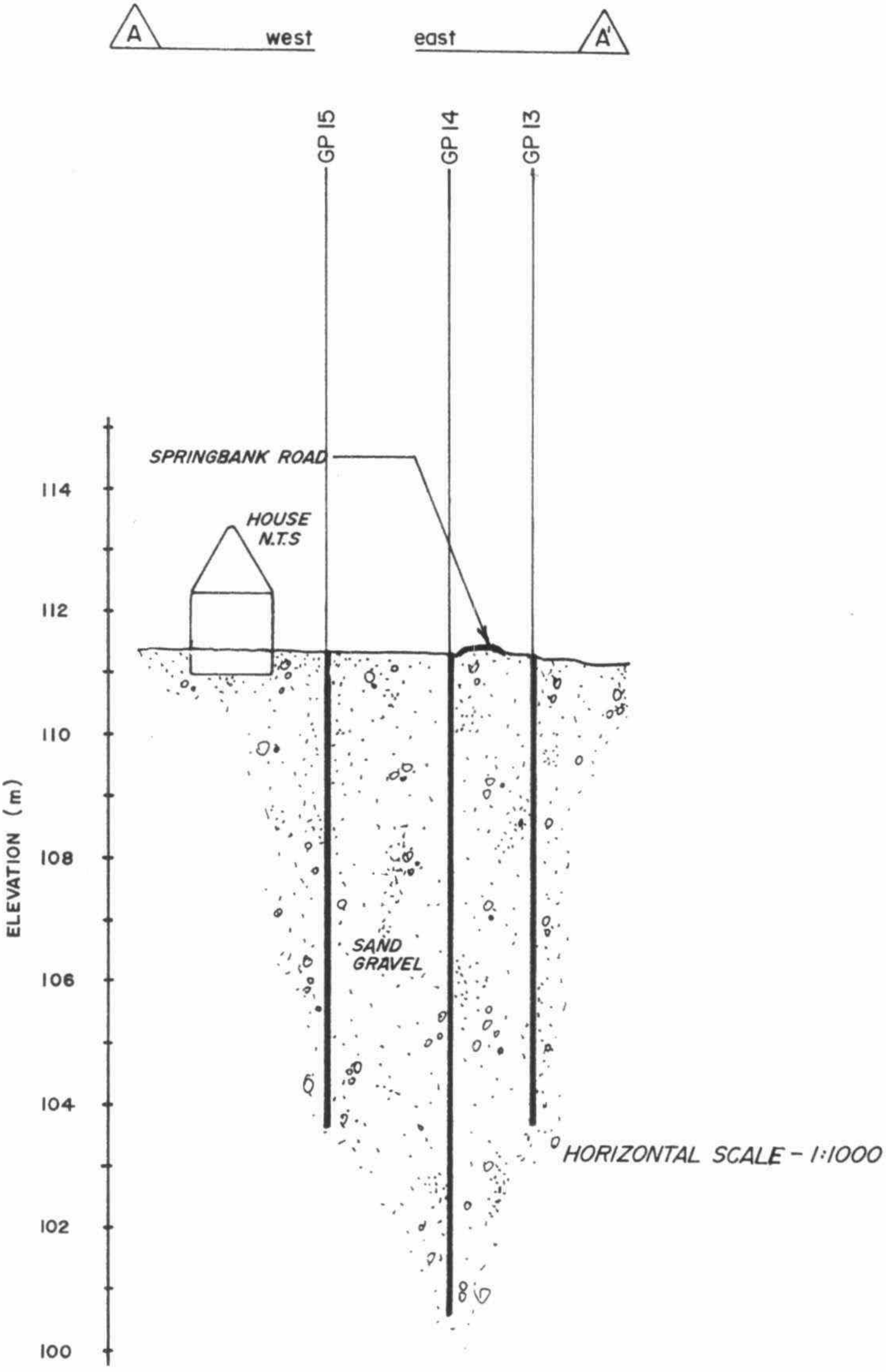
C5



CROSS SECTION A-A'

MINISTRY OF THE ENVIRONMENT
Verification Study Project No. 262-811
Site: No. 7071, Mississauga

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C6

MINISTRY OF THE ENVIRONMENT
Verification Study Project No. 262-811
Site: No. 7071, Mississauga

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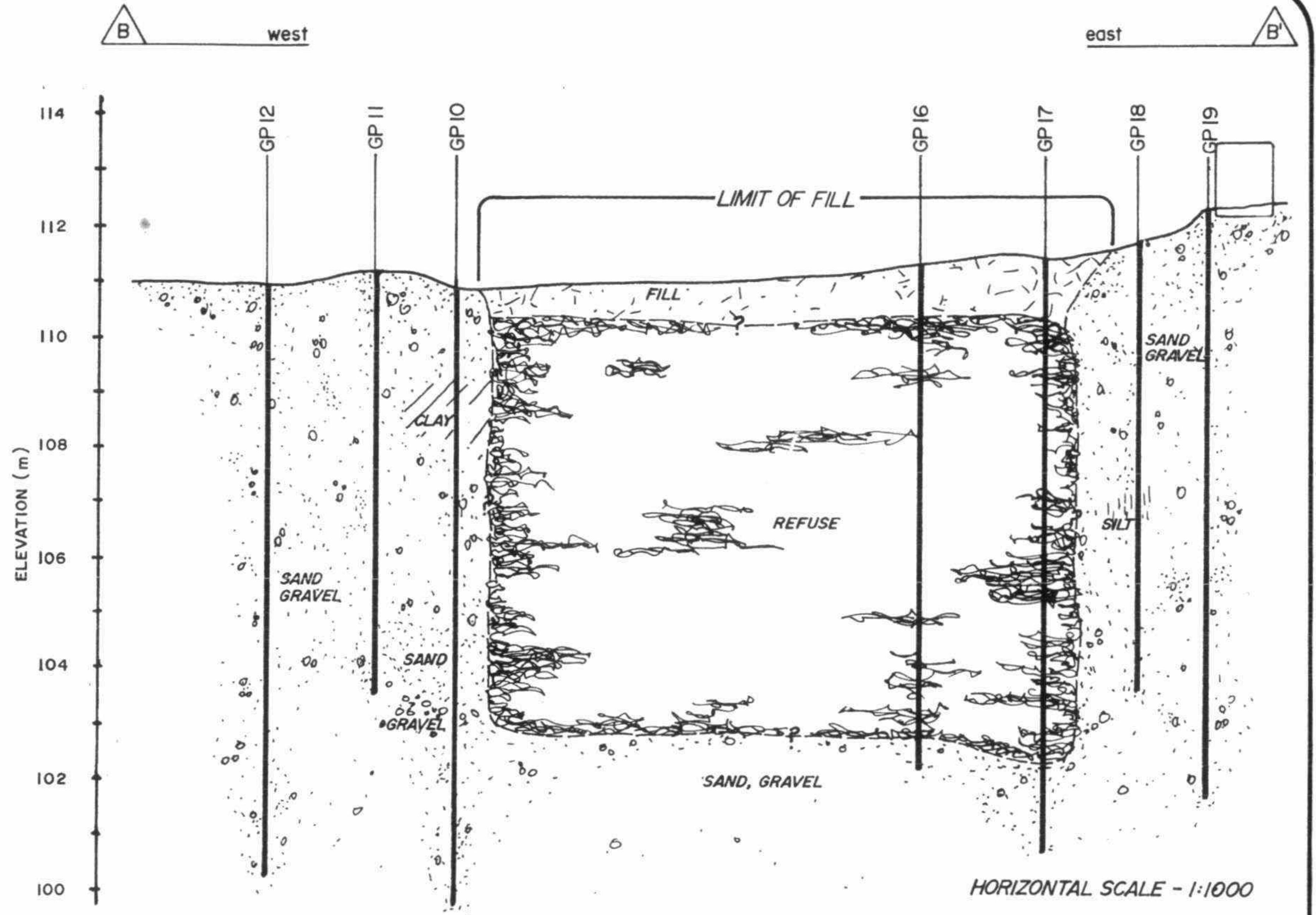
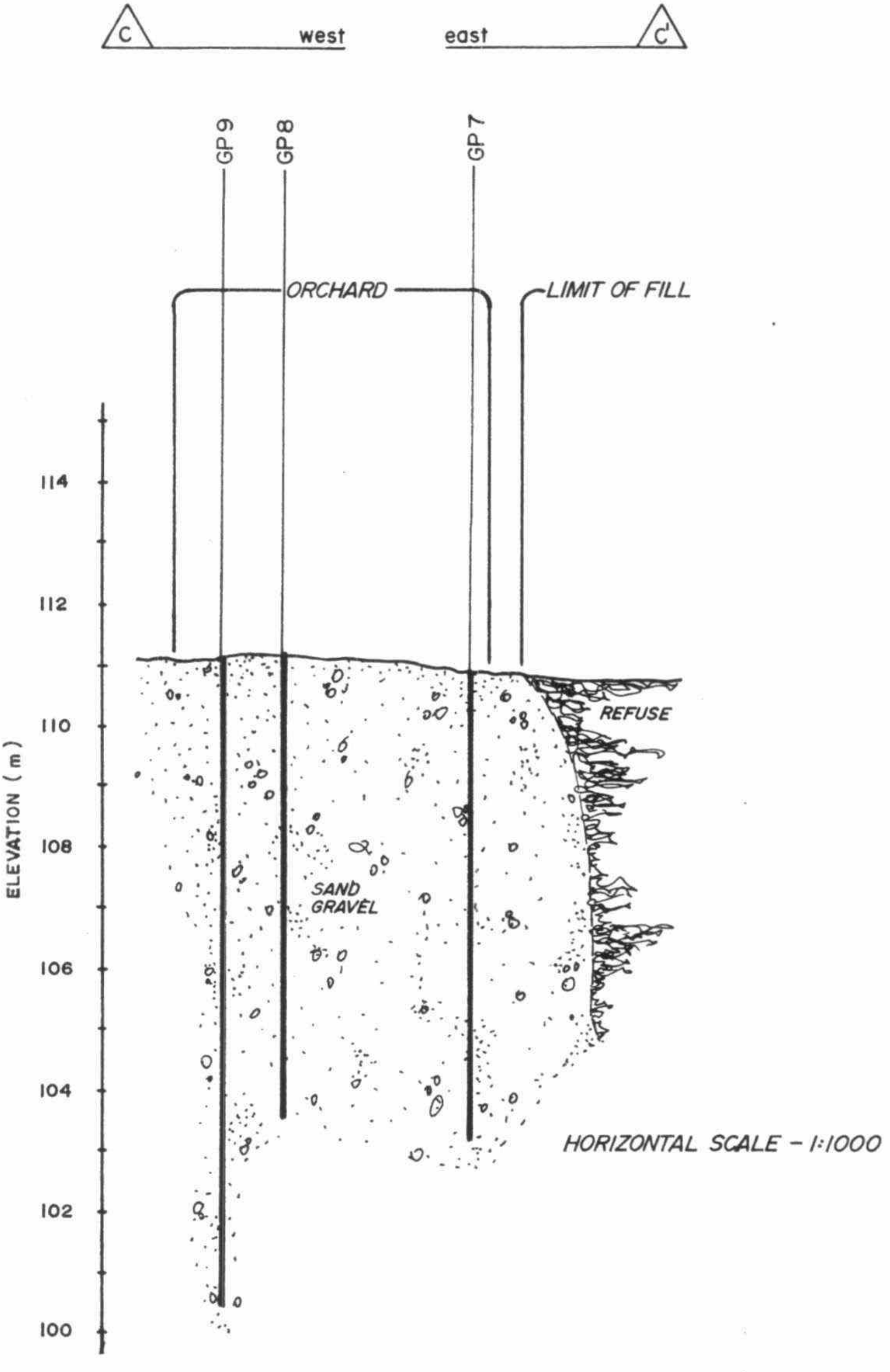
C7



CROSS SECTION B-B'



CROSS SECTION C - C'

MINISTRY OF THE ENVIRONMENT
Verification Study Project No. 262-811
Site: No. 7071, Mississauga

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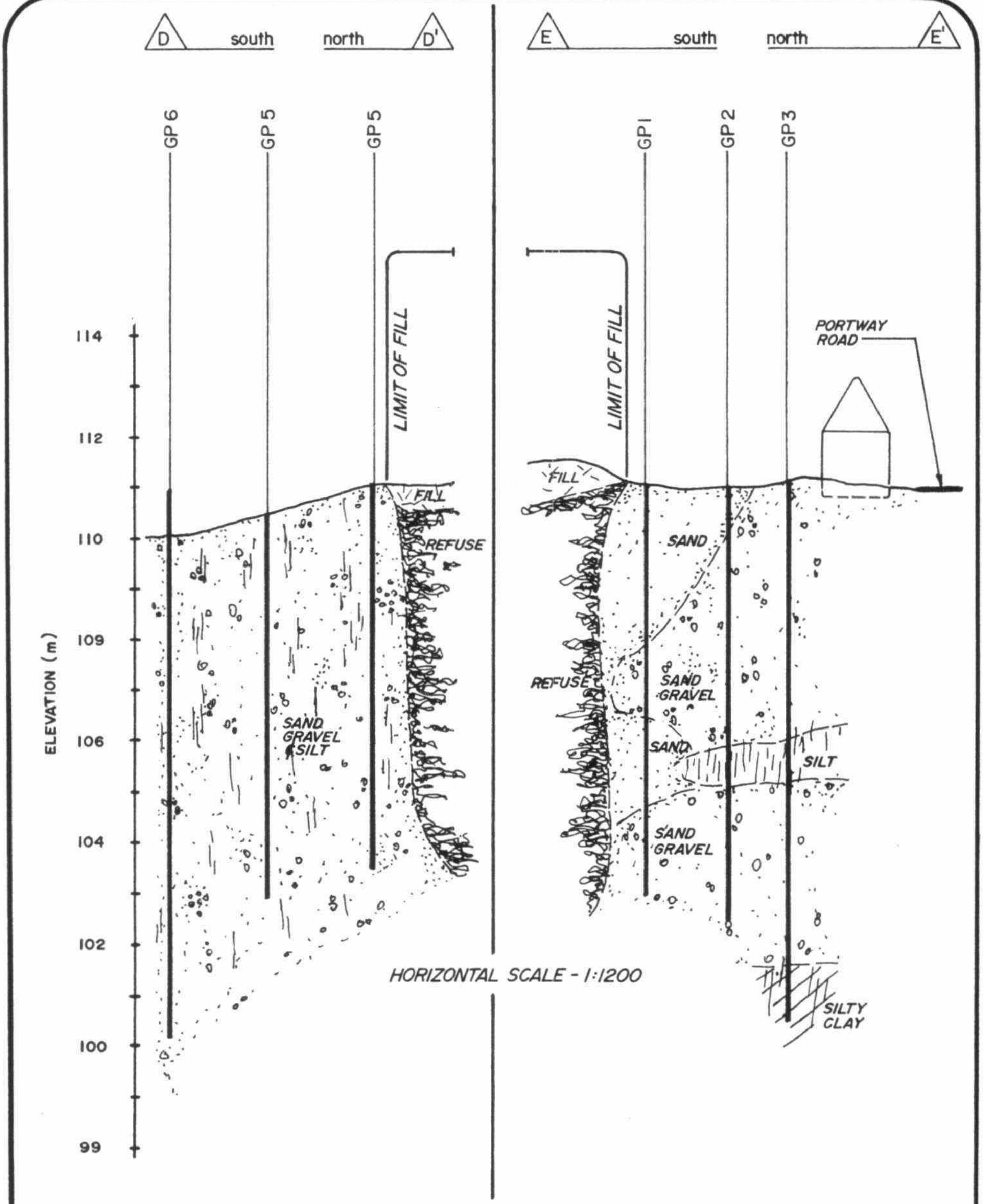
C8



CROSS SECTION D-D' & E-E'

MINISTRY OF THE ENVIRONMENT
Verification Study   Project No. 262-811
Site: No. 7071, Mississauga

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consulting engineers and hydrogeologists

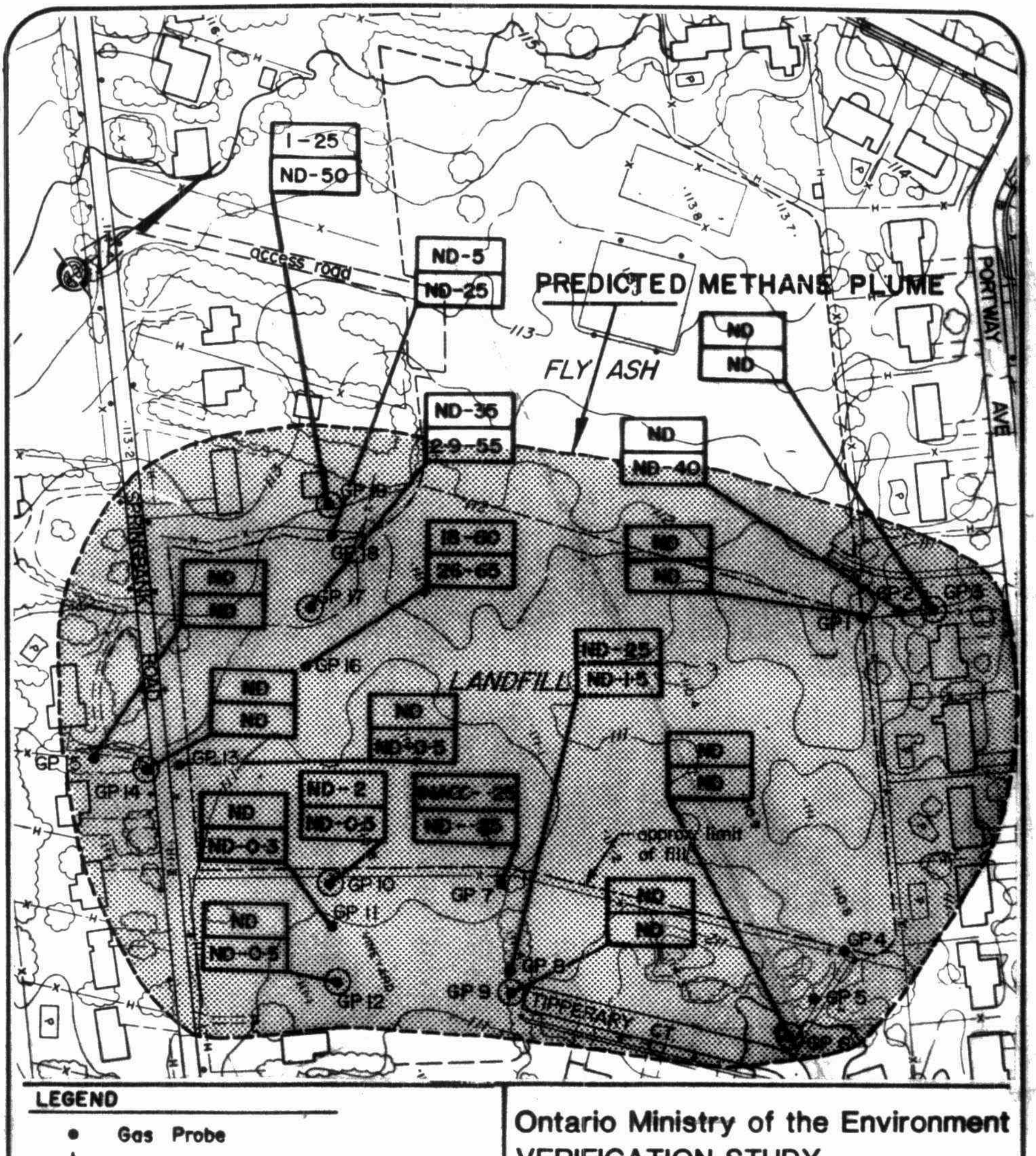
C9

Gas probes were installed in radiating lines away from the disposal area. The lines of probes are listed below:

	Location	Probe Nests
1.	Northeast to Portway Dr.	GP 1, GP 2, GP 3
2.	East towards Tipperary Cres.	GP 4, GP 5, GP 6
3.	North edge of vineyard, towards Tipperary Cres.	GP 7, GP 8, GP 9
4.	Middle of vineyard, toward house on vineyard property	GP 10, GP 11, GP 12
5.	South across Springbank Dr towards 2114 Springbank	GP 13, GP 14, GP 15
6.	West from within disposal area towards and onto property at 2147 Springbank Dr.	GP 16, GP 17, GP 18, GP 19

The twelve month monitoring results are found in Section D, 2.0 of the Technical Data Catalogue. Methane ranges (frozen and unfrozen cover) are shown on Figures C-10 and C-11 along with the predicted methane plume. The results are presented in the following graphs (Figures C-12 to C-20) and have been separated according to the lines of probe nests (listed above).

Methane was not detected in any of the shallow probes at GP 1, GP 2, or GP 3. Generally, concentrations were below the explosive limits in the deep probes except on one occasion when methane was measured at 7.5 percent in GP 1 (deep probe). Methane was found in the deep probes at GP 2 and GP 3 on several occasions, but below the explosive limit. Very little methane appears to be migrating toward Portway Drive, northeast of the site (see Figure C-12).



LEGEND

- ● Gas Probe
- ⊕ Borehole
- ○ Observation Well

SHALLOW PROBES

Range in methane concentration:
- frozen ground (% volume)
- unfrozen ground (% volume)

ND not detected
INACC inaccessable

Metres 100 0 SCALE 1:2000

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VERIFICATION STUDY
Site No. 7071 MISSISSAUGA

METHANE CONCENTRATION - SHALLOW PROBES

PROJECT NO. 262-811 APRIL, 1983

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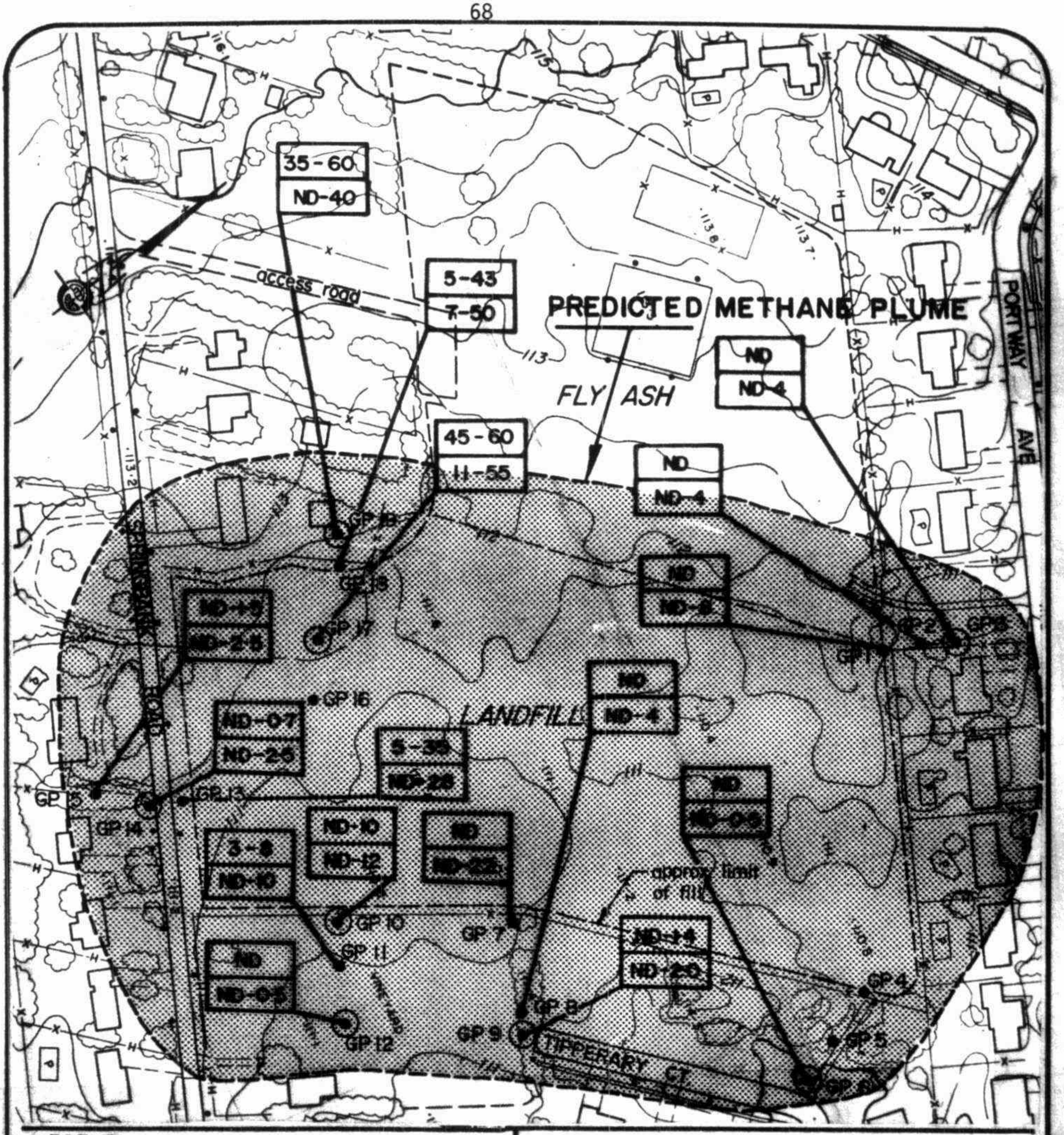
C10



LEGEND

- ● Gas Probe
- ⌖ Borehole
- ○ Observation Well

DEEP PROBES

Range in methane concentration
- frozen ground (% volume)
- unfrozen ground (% volume

ND not detected
INACC inaccessable

Metres 0 100

SCALE 1:2000

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7071 MISSISSAUGA

METHANE CONCENTRATION - DEEP PROBES

PROJECT NO. 262-811

APRIL, 1983

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C11

LS-090681

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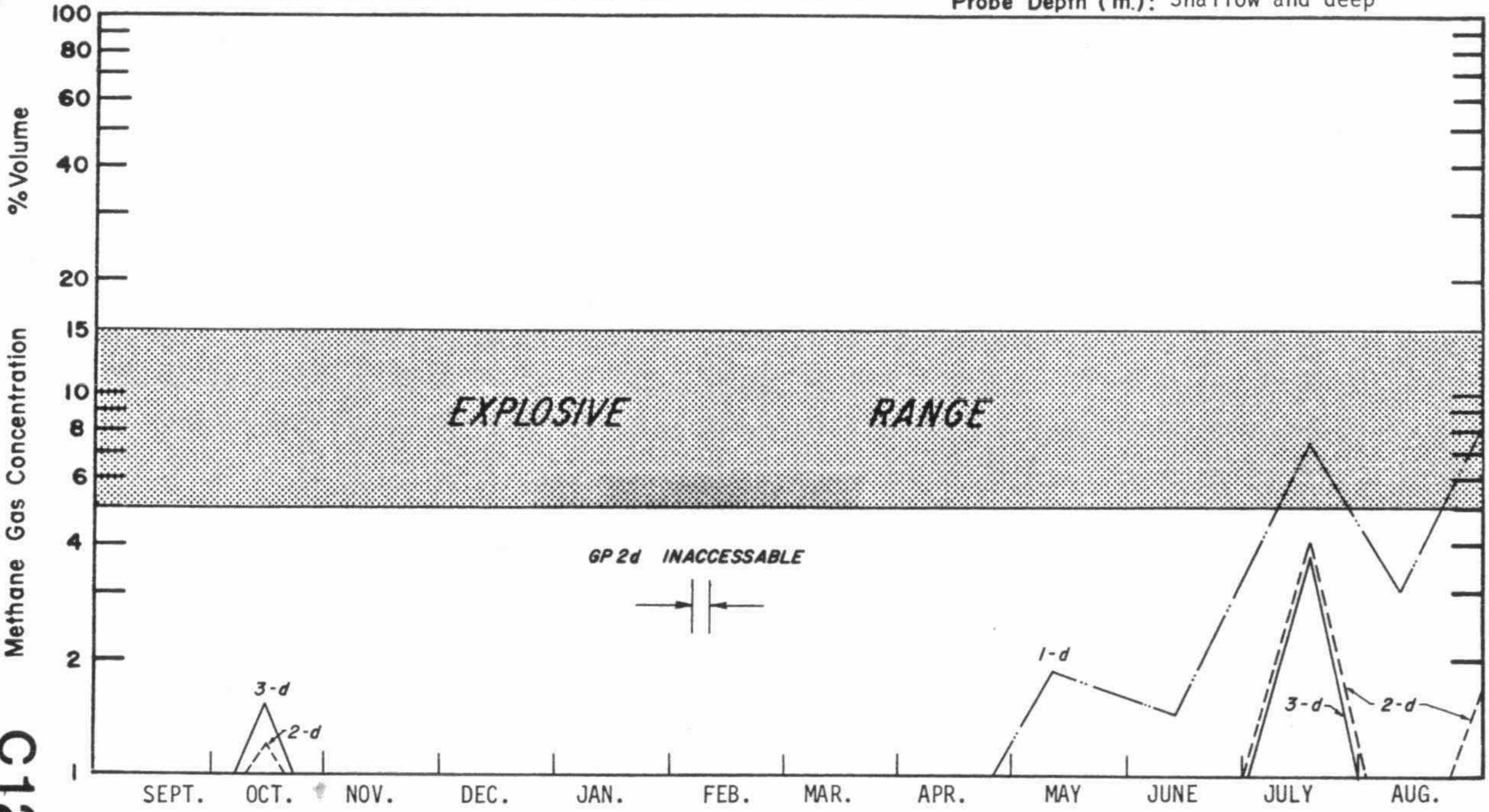
Methane Gas Probe Data

Client Ministry of the Environment **Job No.** 262-811
Landfill location Mississauga **Recorder**
Gas Probe No. GP 1 GP 2 GP 3
Probe location: refuse ☐ **soil** ☐
Probe Depth (m.): Shallow and deep



C12

Time Interval in months

L6-090681

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Methane Gas Probe Data

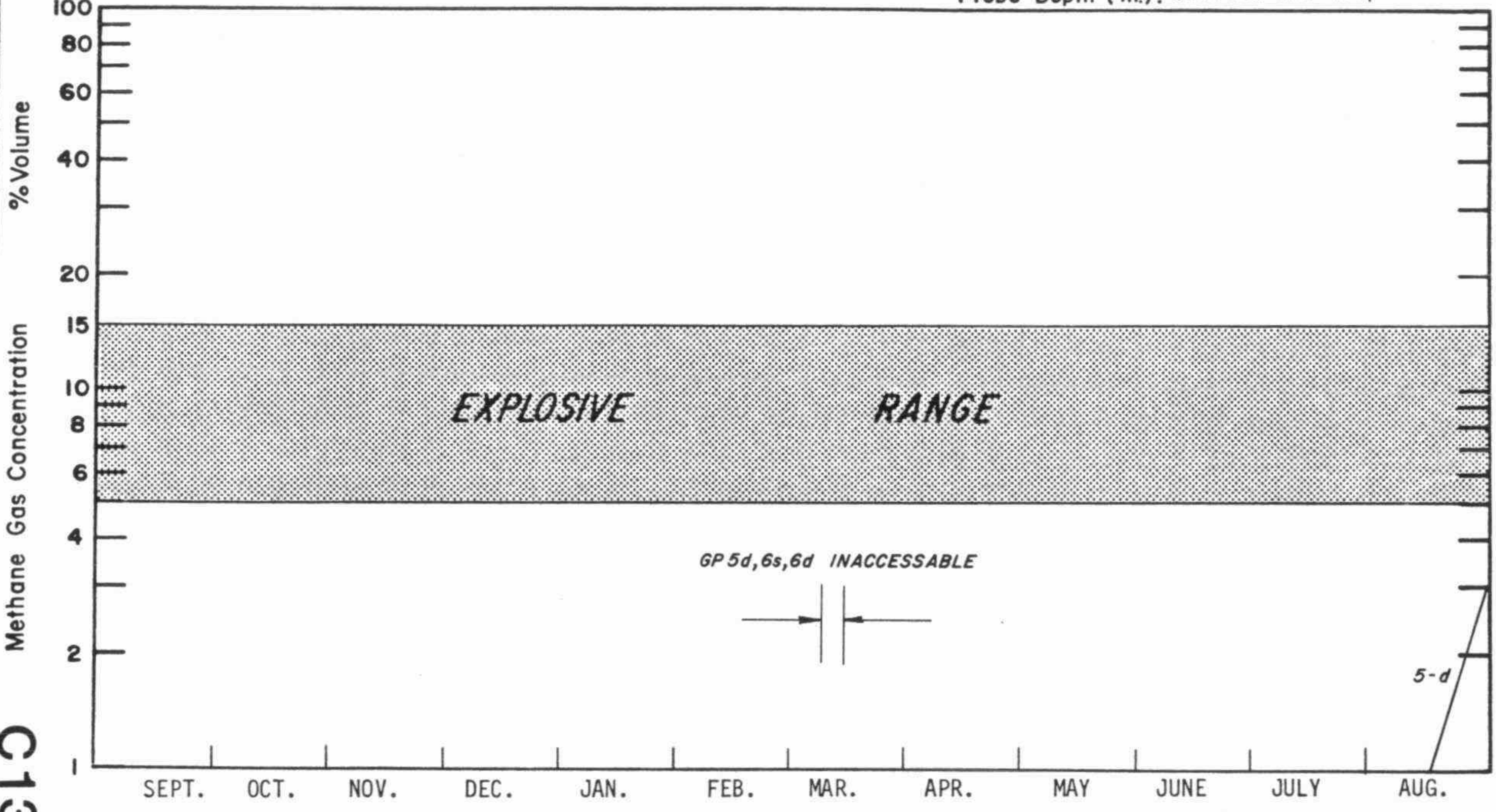
Client Ministry of the Environment **Job No.** 262-811

Landfill location Mississauga **Recorder**

Gas Probe No. GP 5 GP 6

Probe location: refuse ☐ **soil** ☐

Probe Depth (m.): Shallow and deep



C13

Time Interval in months

L6-090681

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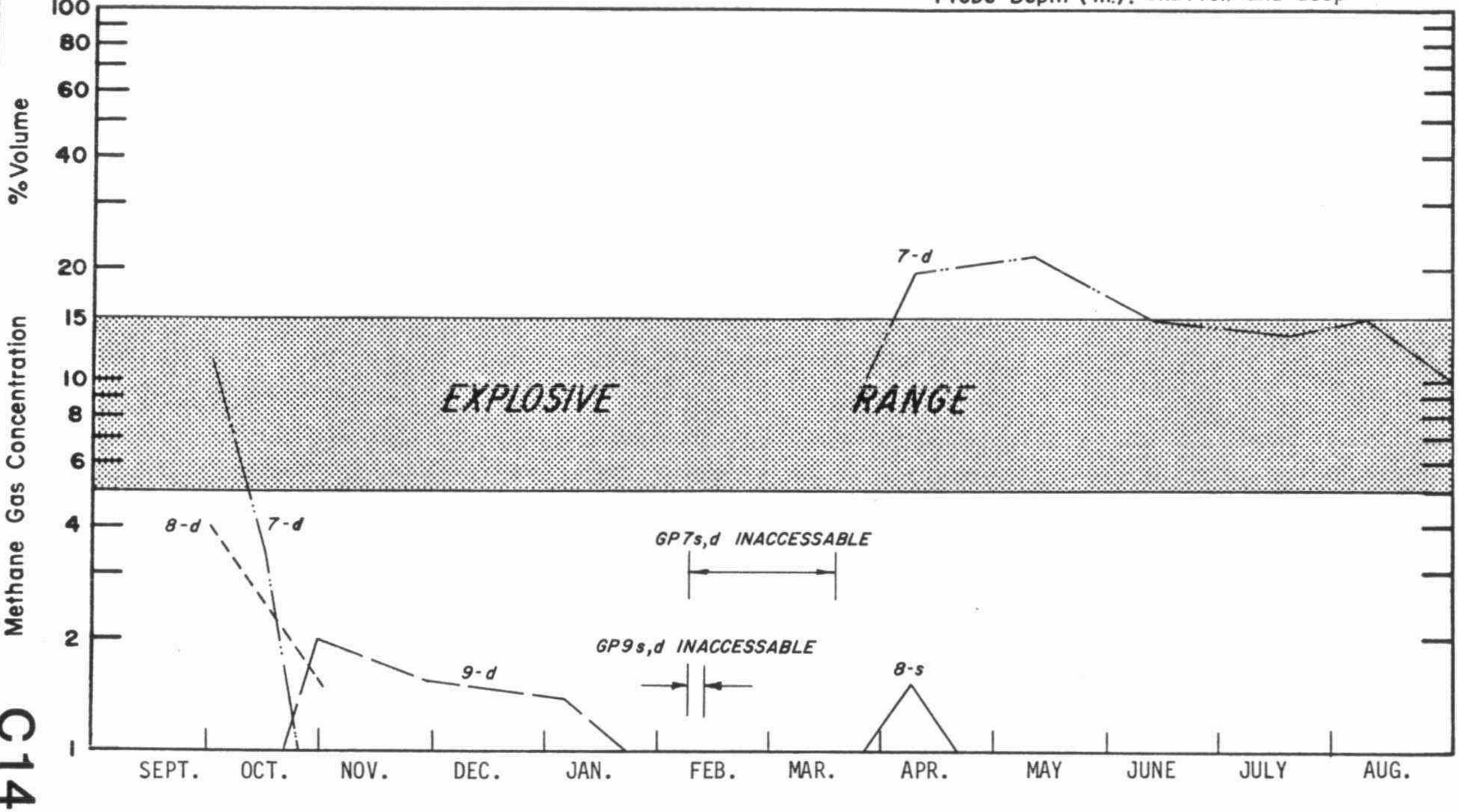
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

Methane Gas Probe Data

Client Ministry of the Environment
Landfill location Mississauga
Job No. 262-811
Recorder
Gas Probe No. GP 7 GP 8 GP 9
Probe location: refuse ☐ **soil** ☐
Probe Depth (m.): Shallow and deep



C14

Time Interval in months

L6-090681

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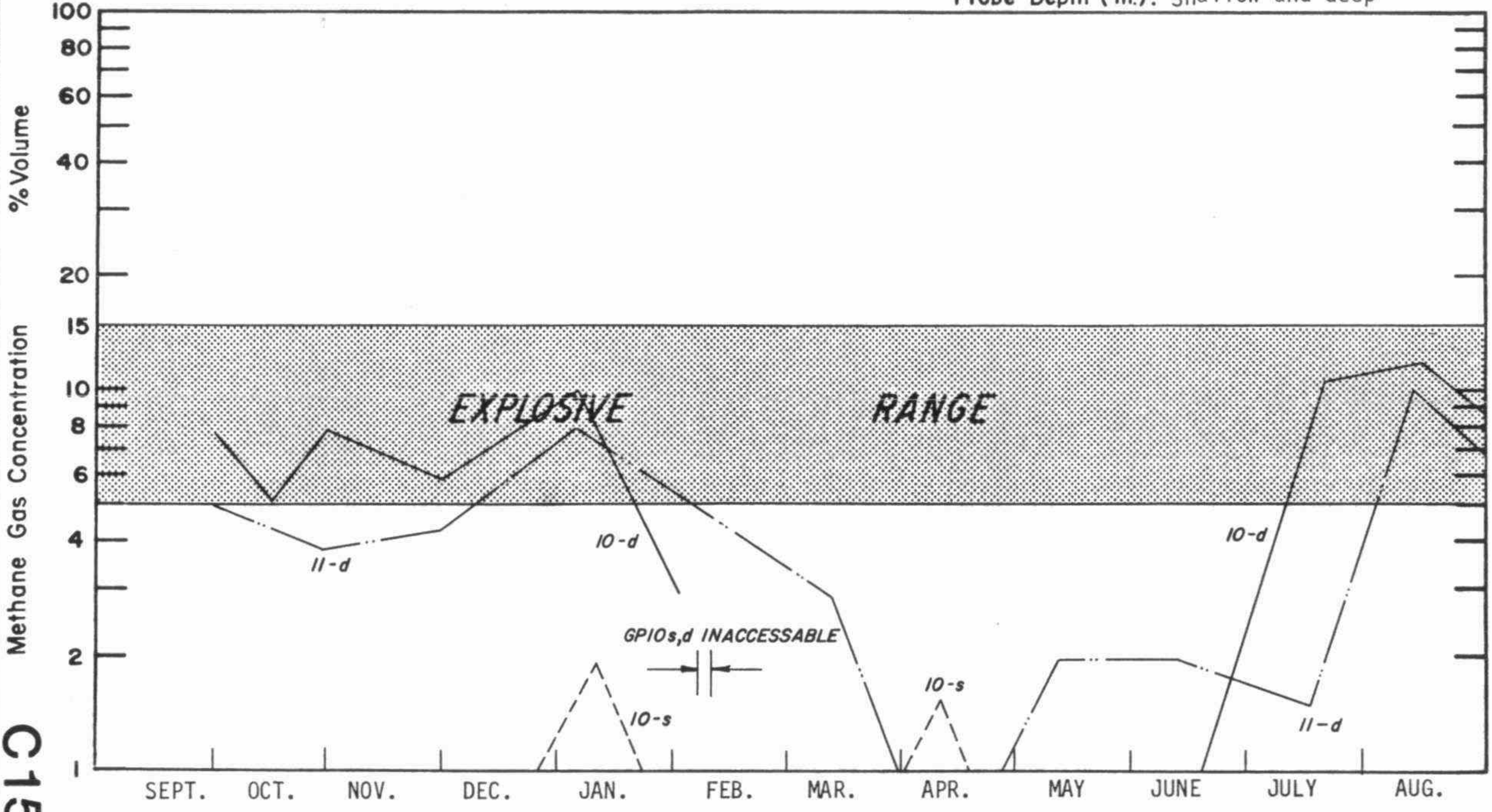
Methane Gas Probe Data

Client Ministry of the Environment
Job No. 262-811
Gas Probe No. GP 10 GP 11 GP 12
Probe location: refuse ☐ soil ☐
Landfill location Mississauga
Recorder
Probe Depth (m.): Shallow and deep



Time Interval in months

C 15

L6-090681

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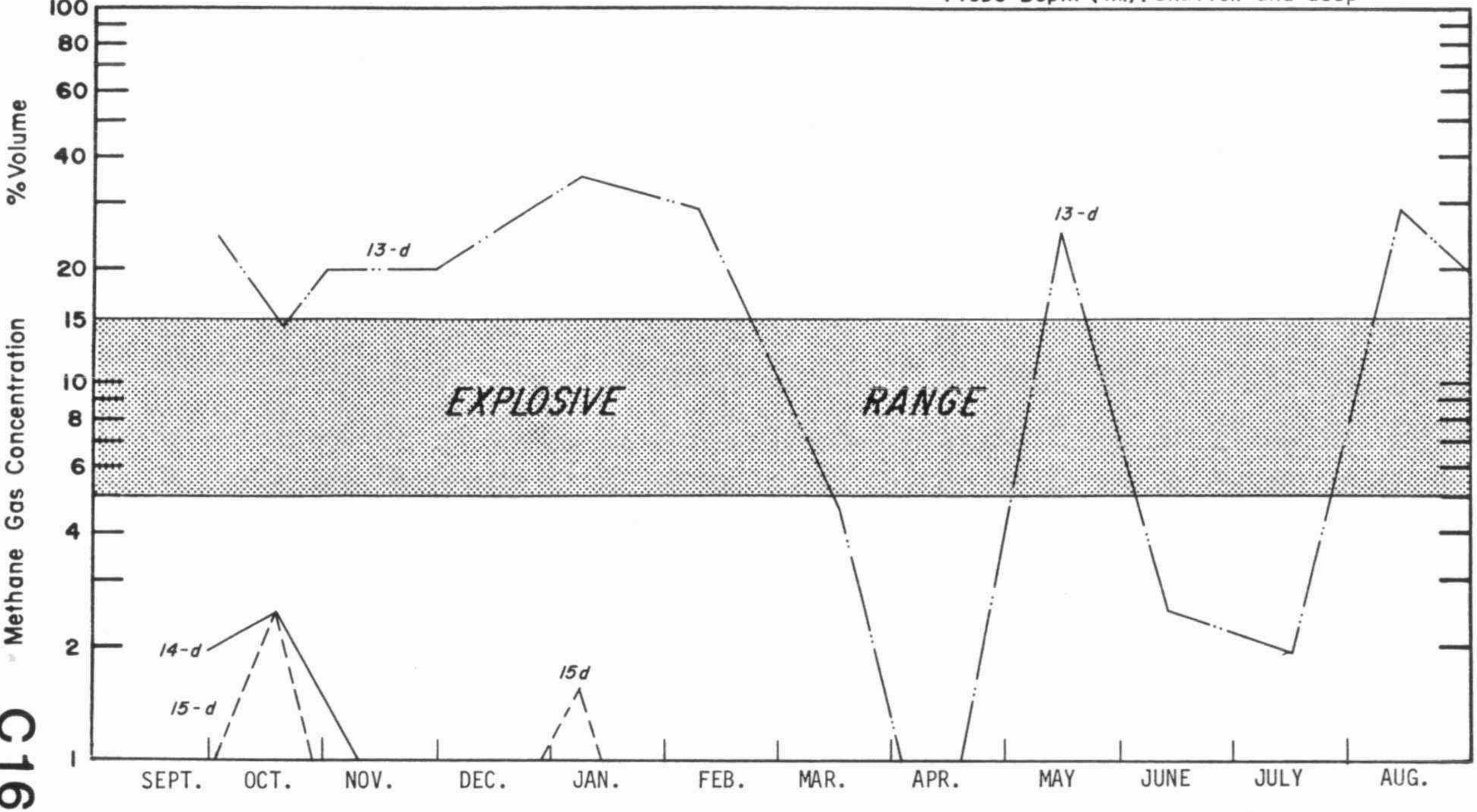
Methane Gas Probe Data

Client Ministry of the Environment **Job No.** 262-811
Landfill location Mississauga **Recorder**
Gas Probe No. GP 13 GP 14 GP 15
Probe location: refuse ☐ **soil** ☐
Probe Depth (m.): Shallow and deep



Time Interval in months

C 16

L6-090681

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Methane Gas Probe Data

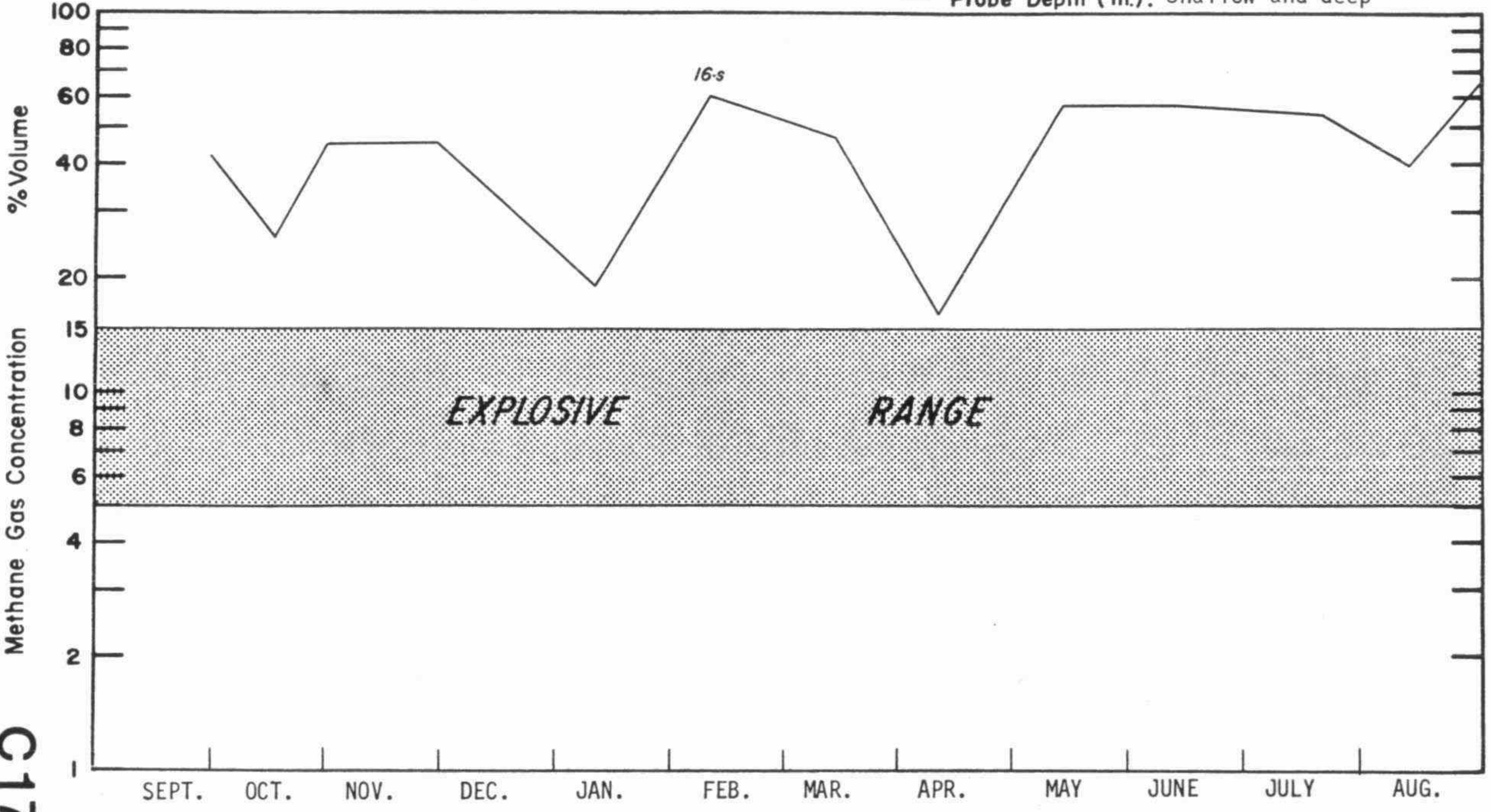
Gas Probe No. GP 16(d) GP 17(s) GP 17(d)

Client Ministry of the Environment **Job No.** 262-811

Probe location: refuse ☐ soil ☐

Landfill location Mississauga **Recorder**

Probe Depth (m.): Shallow and deep



C17

Time Interval in months

L6-090681

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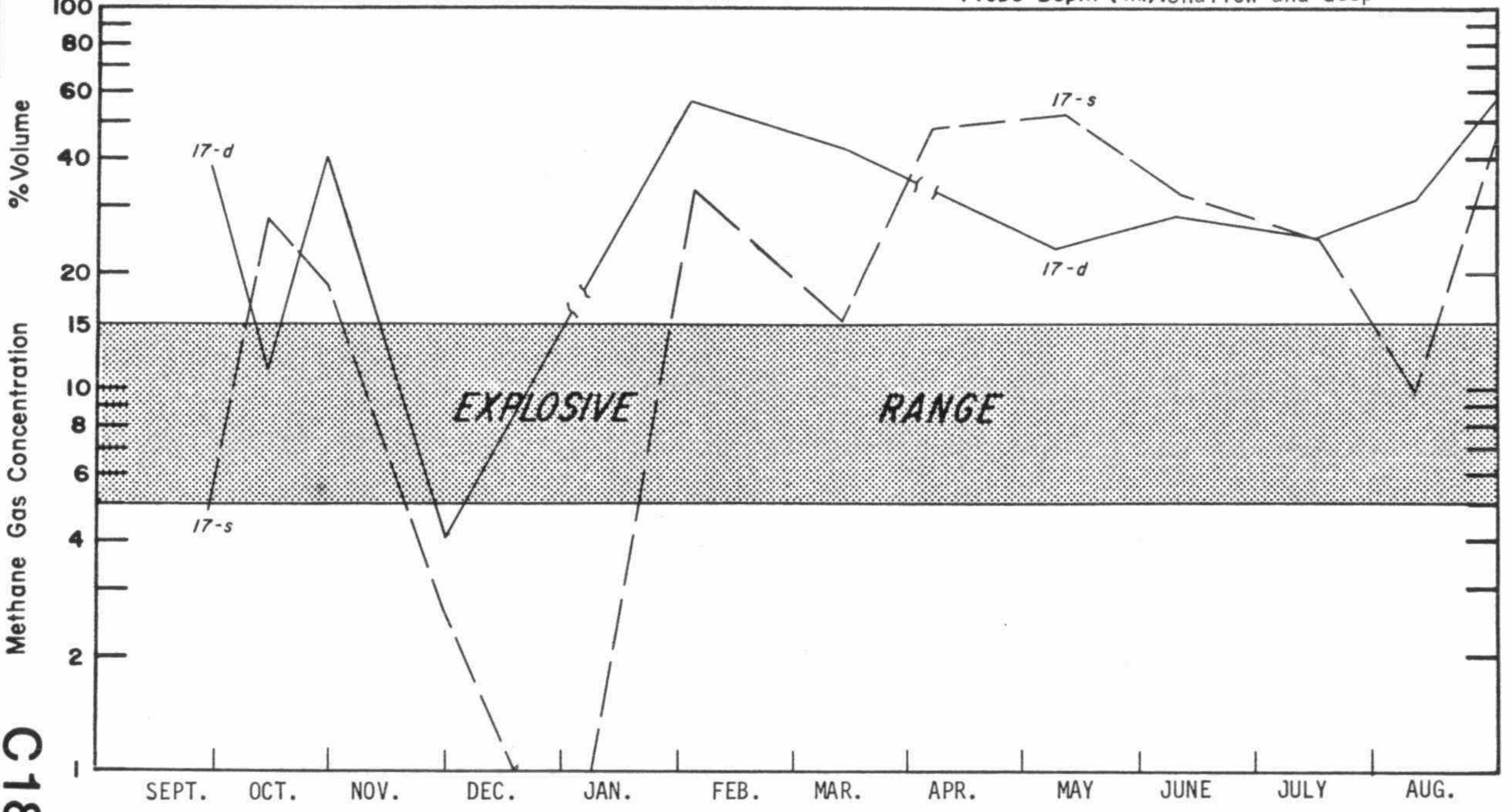
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

Methane Gas Probe Data

Client Ministry of the Environment
Job No. 262-811
Gas Probe No. GP 17(s) GP 17(d)
Probe location: refuse ☐ soil ☐
Landfill location Mississauga
Recorder
Probe Depth (m.): Shallow and deep



C18

Time Interval in months

LG-090881

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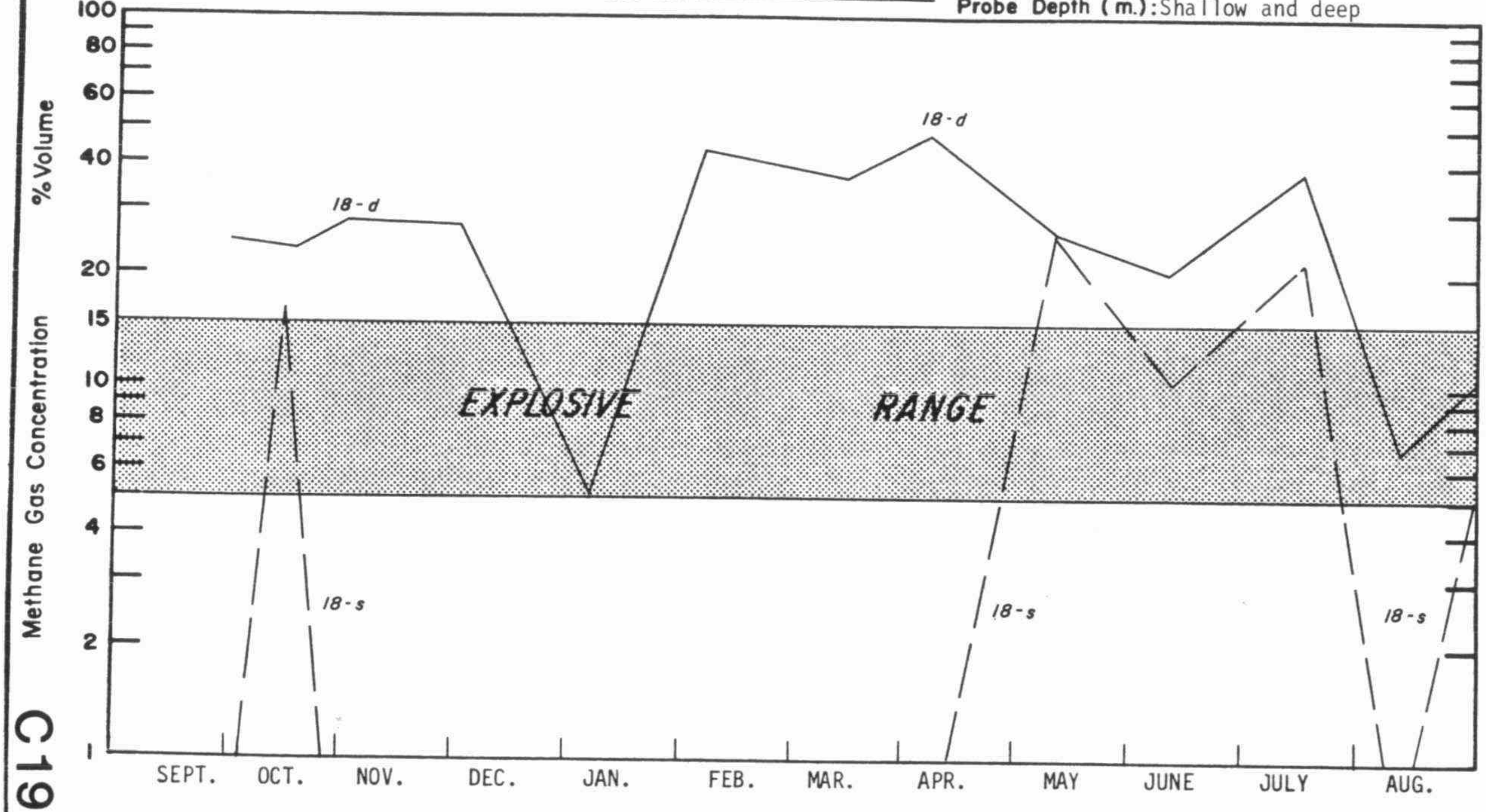
consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

Methane Gas Probe Data

Client Ministry of the Environment
Job No. 262-811
Gas Probe No. GP 18(s) GP 18(d)
Landfill location Mississauga
Recorder
Probe location: refuse ☐ **soil** ☐
Probe Depth (m.): Shallow and deep



Time Interval in months

C19

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consulting engineers and hydrogeologists
290 the west mall, etobicoke, ontario M9C 1C6 (416-622-9374)

L6-090681

Methane Gas Probe Data

Client Ministry of the Environment

Landfill location Mississauga

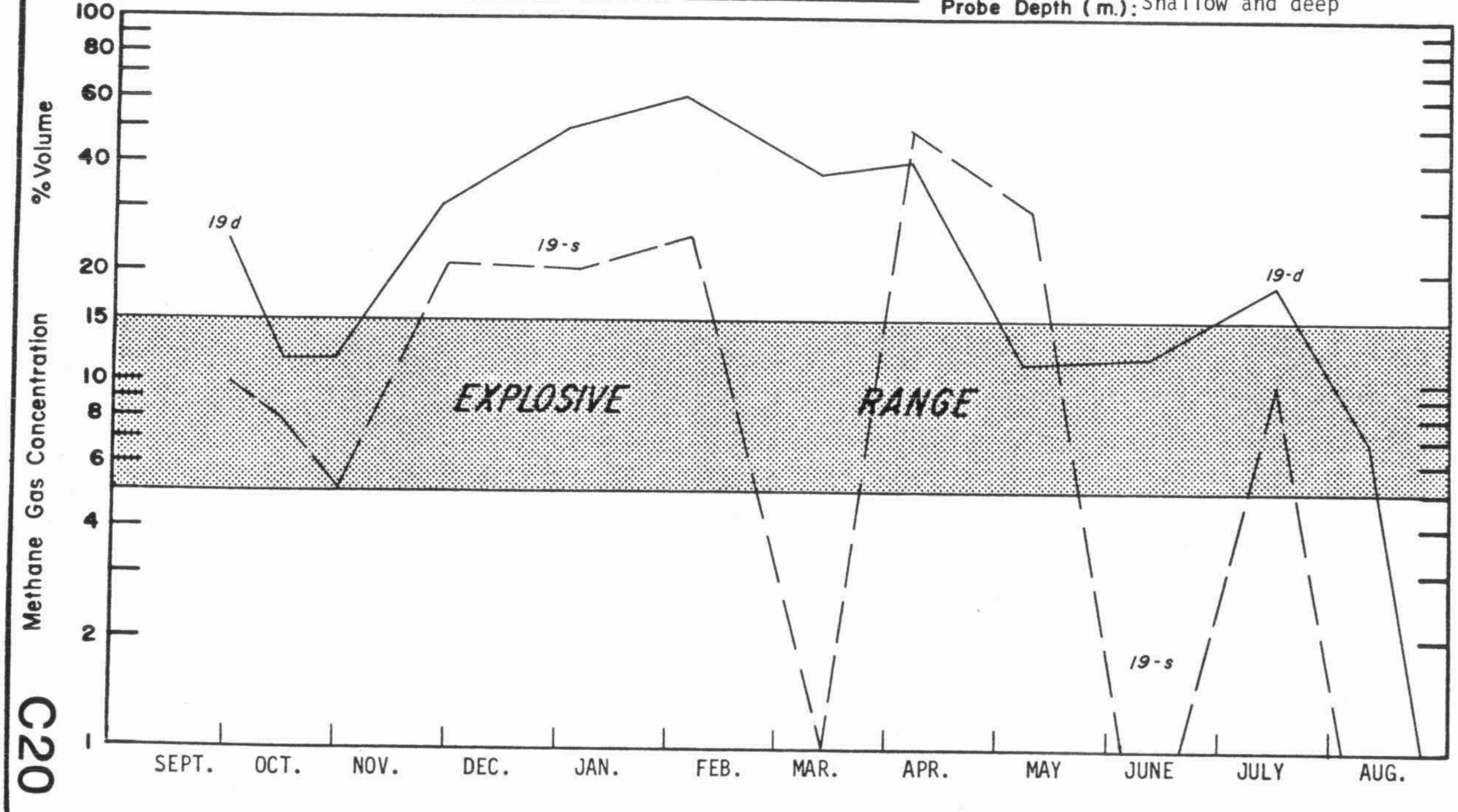
Job No. 262-811

Recorder

Gas Probe No. GP 19(s) GP 19(d)

Probe location: refuse ☐ soil ☐

Probe Depth (m.): Shallow and deep



Time Interval in months

C20

The line of probes radiating towards Tipperary Cres. showed very little methane migration. The two probes at GP 4 and the shallow probe at GP 5 were destroyed before any readings could be obtained. Methane was detected in GP 5 (deep) on three occasions within the summer months. However, concentrations were below explosive levels. Only a trace amount of methane was recorded at GP 6, (deep probe) and only on one occasion over the twelve month period. As with the northeast area of the site it appears very little methane is migrating away from the corner of the site.

The GP 7, GP 8, GP 9 line of gas probe nests are located on private estate property abutting the Tipperary Crescent properties (see Figure C-4). Concentrations up to and beyond the explosive limit were measured at GP 7 (deep). The deep probe at GP 9 (about 25 m, from landfill and adjacent to Tipperary Cres) showed methane concentrations up to 2.0 percent (below explosive limit). The highest concentrations and farthest migration in this case were when ground surface was unfrozen (i.e., April to November).

The line of GP 10, GP 11, and GP 12, also located within the above-noted estate property showed migration to about the same distance as at GP 7, GP 8 and GP 9, but had a different seasonal pattern. As would be expected, methane was detected in the shallow probes during frozen cover conditions (January) or when saturated conditions occur (early April). Maximum migration occurred from October to December when trace levels were found in GP 12 (deep) about 25 m from the disposal area.

GP 13, GP 14, and GP 15 are shown on Figure C-3 radiating southward towards 2114 Springbank Drive. GP 14 and GP 15 are located close to the property boundary of 2114 and 2132 Springbank Drive and on the opposite site of the street from the disposal area. The Mississauga landfill site backs the south side of these residences.

The shallow probe at GP 13, next to the disposal area, had a small amount of methane (0.5 percent) on only one occasion and during unfrozen conditions. The shallow probes at the other two probe nests (GP 14 and GP 15) located farther from the disposal area did not have methane on any monitoring date.

The deep probes in this line of probe nests showed the presence of methane on a number of occasions. The deep probe at GP 13 had a wide range of methane concentrations (0 to 35 percent, see Figure C-16). The deep probe at GP 14 on the south side of Springbank Dr., had low methane concentrations (0 - 2.0 percent) on most occasions with the exception of April to August when no methane was detected. The deep probe at GP 15 had low concentrations on several occasions (see Figure C-16).

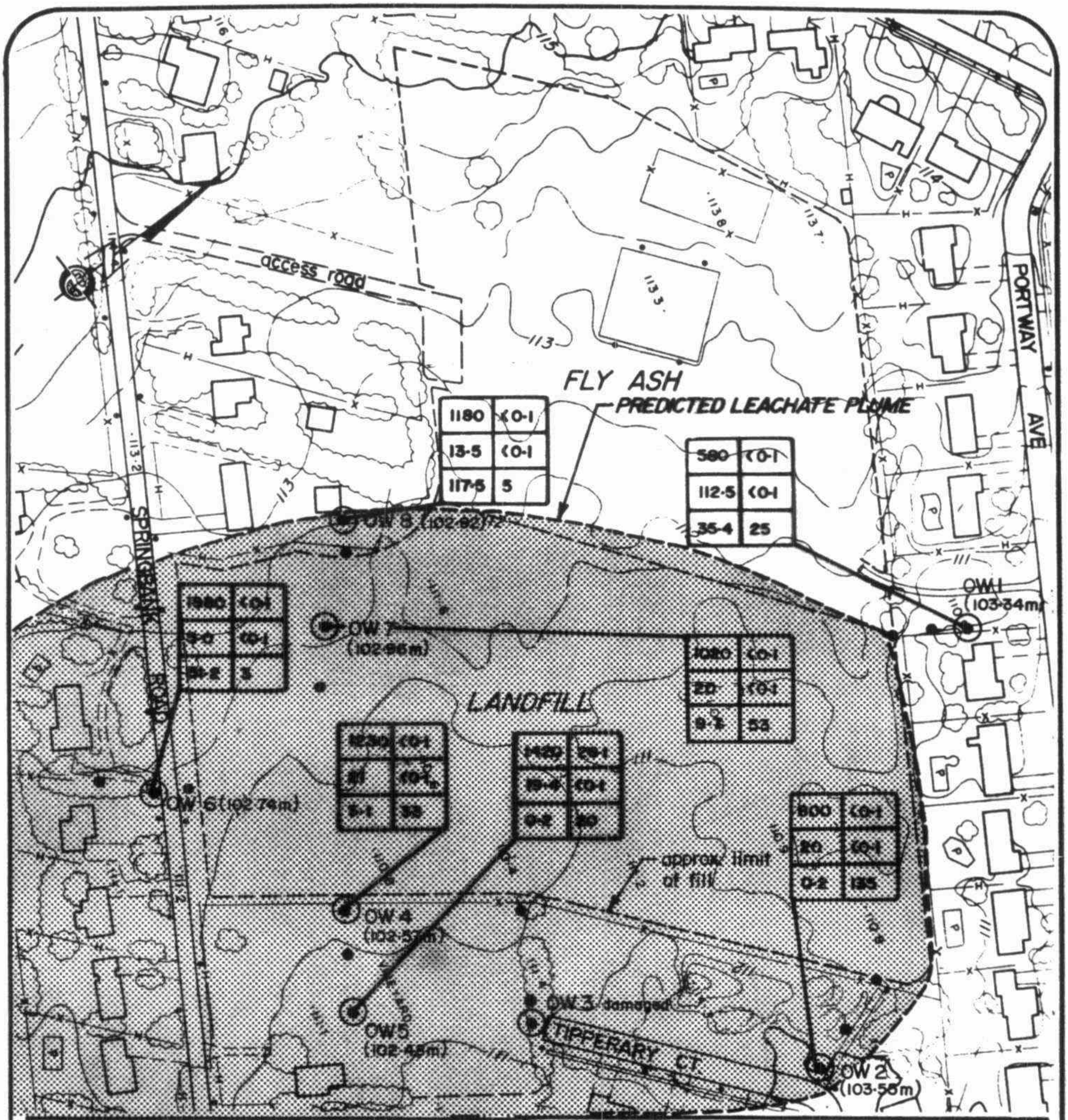
The line of gas probes showing the greatest potential hazard radiates from the southwest area of the site towards the property at 2147 Springbank Drive. GP 16 is within the landfill refuse. As expected, methane concentrations were high (16 - 65 percent) throughout the year. (see Figure C-17) The shallow and deep probes at GP 17, also within refuse both had high concentrations of methane. GP 18 (shallow) located several metres from the fill limit ranged from 0 to 25% and GP 18 (deep) from 5 to 43%. These concentrations are much higher than other probes similar distances from the disposal area (i.e., GP 1, GP 7, GP 10, and GP 13).

GP 19 (shallow and deep probes) show unexpected high levels of methane. These probes are located approximately 25 m from the site yet had consistently high concentrations of methane (above explosive limit). The exceptions were June, August, and September, 1982 readings at GP 19 (shallow) and the September 1982 reading at GP 19 (deep), when no methane was detected. This probe nest is located within 3 m of a dwelling behine the main residence at 2147 Springbank Drive. The residence is also within the same distance from the disposal area. The basement rooms were monitored for methane migration on several occasions; but none was detected.

Leachate

As outlined under Study Methodology, Section A, 1.0 of the Technical Data Catalogue, observation wells were installed and monitored on two occasions. Eight observation wells were installed at this site. Their locations are shown on Figure C-5. OW 3 was destroyed before any monitoring results could be obtained.

Water samples were otbained and analyzed on two occasions. The results of both analyses are found in Section D, 5.0 of the Technical Data Catalogue. Selected parameters for each well are presented on Figure C-21. OW 1 is representative of background water quality. The impact of this site on groundwater is not great at the present time. The major parameters are only elevated about 2.4 times in the wells closest to the site.



LEGEND

- ● Gas Probe
- Borehole
- ○ Observation Well

Conductivity	Cond.*	NH4	Free Ammonia
Chlorides	Cl	P	Total Phosphorous
Sulphates	SO4	TOC	Total Organic Carbon

Concentrations in mg/l except as noted * umhos/cm

Ontario Ministry of the Environment
VERIFICATION STUDY
Site No. 7071 MISSISSAUGA

GROUNDWATER QUAILTY

PROJECT NO. 262-811

APRIL, 1983

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C21

4.3.5 Gas Pumping Test

The pumping test took place on October 15, 1981. The pumping well (GP 16-d) is located within the landfill at a depth of 8.5 m. The well construction details are included in Section A of the Technical Data Catalogue. This well was constructed in the same manner as the wells at Site 3045 and Site 7060 with the exception that a longer screen was used (3 length).

The pumping test was conducted at a rate of 20 cc/s or 30 cfm for 170 minutes. Methane concentrations decreased slightly in shallow probes due to recharge of atmospheric air from the surface. This effect was felt up to 40 m from the pumping head. Deep probes outside of the landfill boundary also showed some decrease in methane concentrations during the pumping test. Deep probes within the landfill had fluctuating methane readings but did not show the same decreasing trend.

Graphs showing pressure change over time, percentage methane over time and pressure drawdown are Shown on Figures C-22 and C-23. Graphs of the pumping test are included for both the shallow and the deep probes.

4.3.6 Potential Impacts

Methane migration is expected to continue for some time at this site. There is a potential for methane to migrate into residences near the site, especially both buildings at 2147 Springbank Drive. There is also a possibility of migration of small volumes of methane through soils beneath residences on Portway Cres., Tipperary Cres. and the south side of Springbank Drive.

Continued uneven settlement and vegetation stress over the entire site can be expected.

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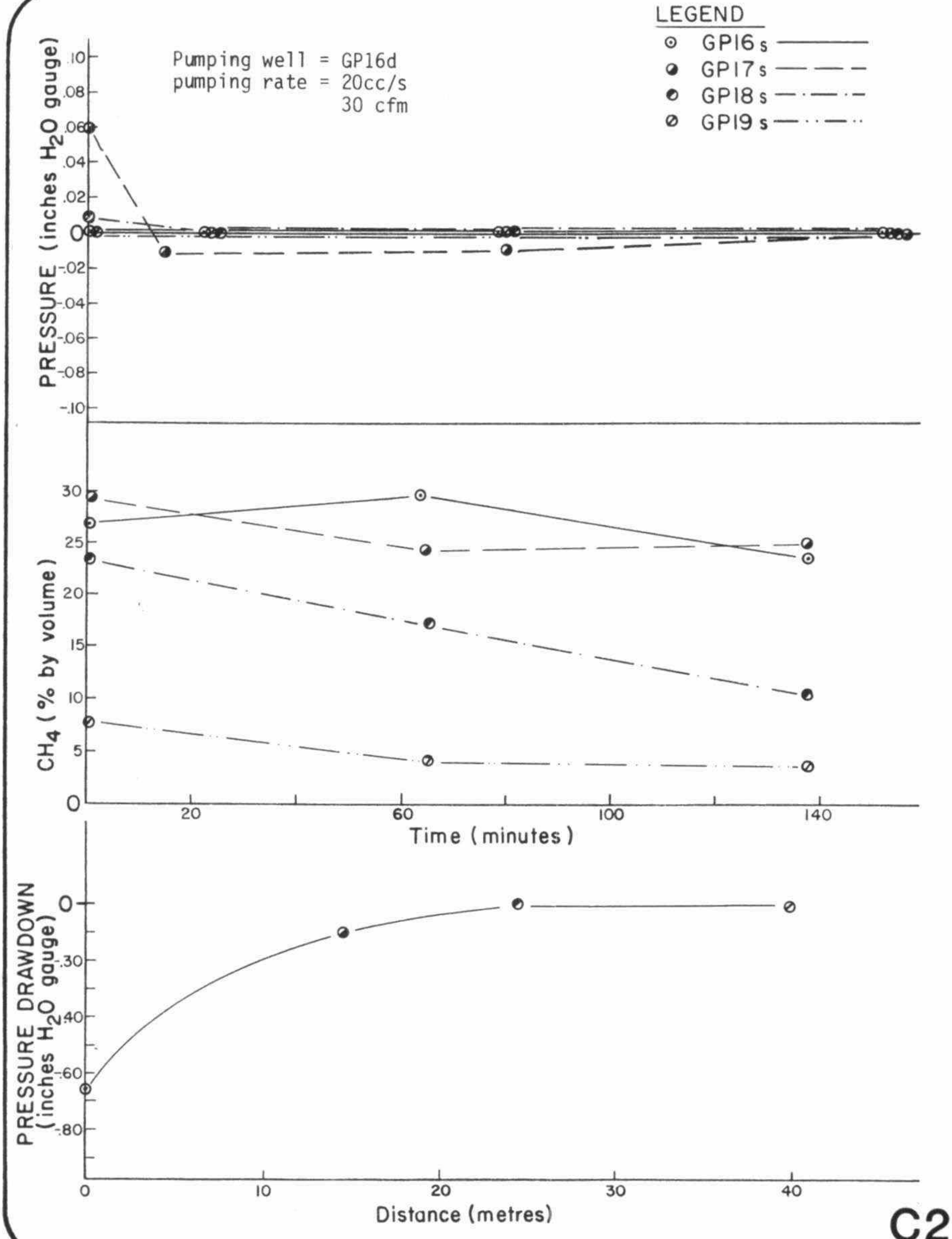
GAS PUMPING TEST
M.O.E. VERIFICATION STUDY
SITE NO. 7071 Mississauga
Shallow probes (1.5 m below surface)



C22

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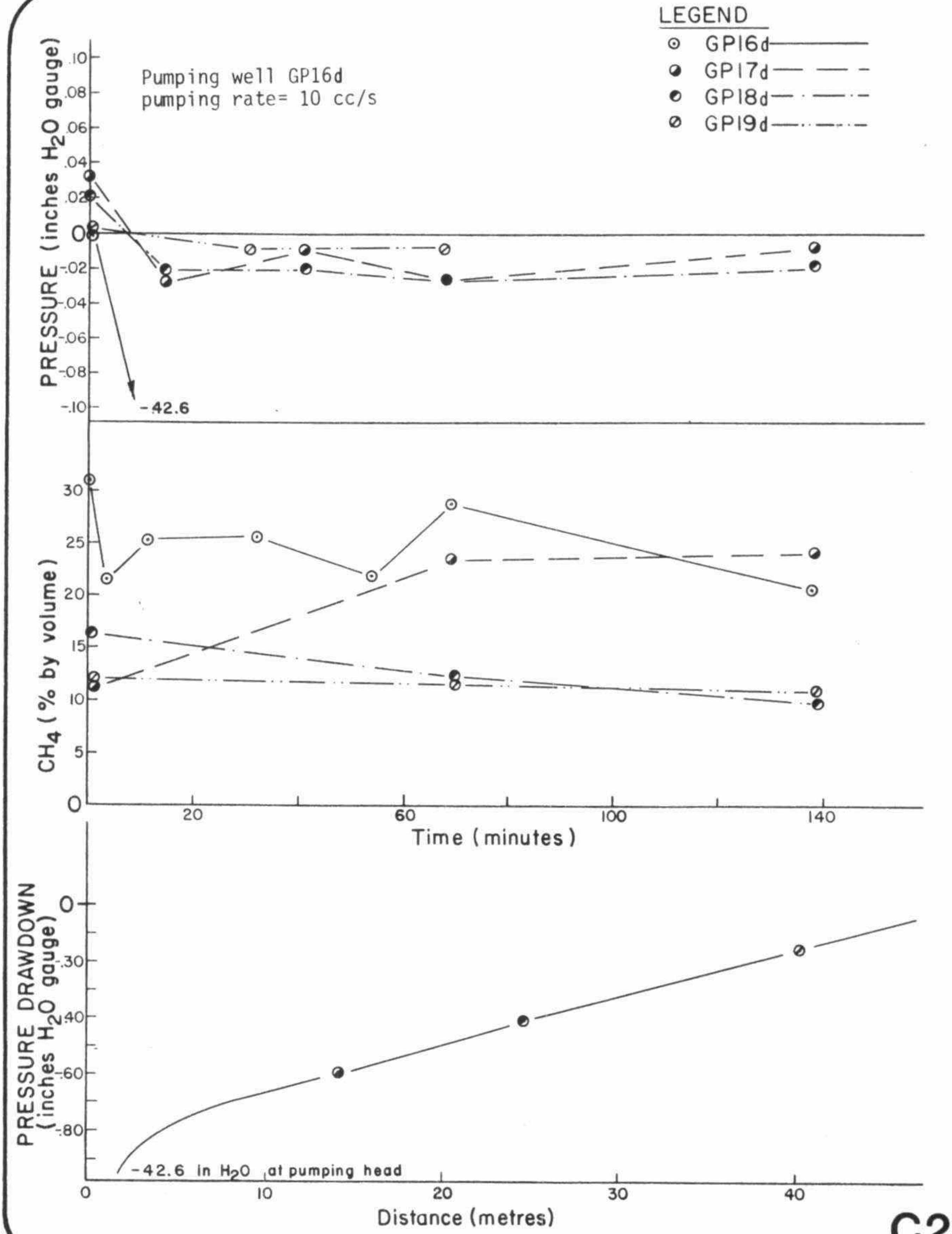
GAS PUMPING TEST
M.O.E. VERIFICATION STUDY
SITE NO. 7071, Mississauga
Deep probes (7.5 m below surface)



C23

Leachate will continue to be produced at this site. The quantity of leachate will not change unless surface conditions change sufficiently to effect the amount of infiltration into the refuse. However, the strength of leachate is expected to decrease as the age of the site increases.

4.3.7 Recommendations

The preliminary study placed this site into a "probable hazard risk" category. The Verification Study confirmed this situation.

Therefore, it is our recommendation that:

1. Determine a method by which the "limits of fill" and the requirements for methane controls can be permanently recorded in public records.
2. Gas detectors should be installed in all residences adjacent to the landfill site on Portway Cres. and Springbank Drive.
3. A methane monitoring program should be established involving the existing probes. The program should monitor methane during the winter months.
4. A gas control system should be considered for the present developed areas adjacent the site. If development is proposed for the vacant properties along the southeast boundary of the site, a gas control system should be installed in this area also.

4.3.8 Comparison of Results

The following chart outlines the results of the Verification Study for the Mississauga site compared to the results of the preliminary field investigations:

TASK	STUDY RESULTS Preliminary Study	 Verification Study
1. Identify Leachate Seeps	- none	- same as preliminary study
2. Identify Vegetation Stress	- found over entire site, at perimeter and on edge of vineyard	- same as preliminary study
3. Hydrology & Drainage	- high infiltration - site is depressed from surrounding area - no streams nearby	- same as preliminary study
4. Local Geology	- sand and gravel deposits - Lake Iroquois beach deposits	- same as preliminary study
5. Limits of Fill	- occupied former sand and gravel pit - limits of fill were well known - depth of fill estimated at 15 m	- fill limits were refined slightly at west edge as a results of drilling program - depth of fill determined to be about 9 m
6. Composition of Fill	- domestic waste	- same as preliminary study - samples taken
7. Type of Cover	- clayey soil observed compared to sand over-burden off-site	- clayey cover material to a depth of about one metre.
8. Hydrogeologic Characteristics	- water table assumed at about 14 m - highly permeable sands and gravel - direction of groundwater flow assumed to be southward	- water table about 9 m below surface - groundwater flow south with a slight easterly component

9. Volume of Waste	- estimated at 6 ha in area and 15 m deep - total volume 940,000 m^3	- confirmed to be about 6 ha in size but 9 m deep - total volume 560,000 m^3
10. Leachate Quality and Quantity	- leachate seepage not a problem at this site - groundwater is not used as a domestic water supply	- leachate quality and impacts determined - leachate is not a problem at this site
11. Methane Concentrations	- 35% methane in landfill - methane migration possible up to 100 m	- methane up to 65% in landfill - methane migration confirmed up to 30 m - migration only in deep probes at low concentrations towards Portway Cres. - migration of methane within explosive range up to 20 m from landfill toward Tipperary Cres. - methane in deep probes lower than explosive range at 2114 Springbank - high levels of methane in foundation probe at 2147 Springbank Dr.
12. Methane Seepage into Buildings	- none detected - migration of methane off-site found between site and Tipperary Cres. - migration in other directions expected	- no methane migration into houses detected
13. Identified Impacts	- migration into residences	- methane is being produced at site - migration towards residences is occurring - methane found at foundation of building at 2147 Springbank Dr.

14. Potential Impacts	- migration to residences on Portway Cres. - migration to residences on Tipperary Cres. - methane migration to residences on Springbank Drive	- same as previous study especially 2147 Springbank Dr.
15. Remedial Recommendations	- install multi-depth probes - establish a monitoring program - no building on site	- monitoring program still required - restrict any residential development on site - install gas detectors in residences where methane is found in foundation probes - gas controls recommended

The Verification Study in this case refined the knowledge of a methane migration impact away from the landfill site. We knew from the preliminary study a potential hazard existed. The Verification Study identified the areas of specific concern.

5.0 DISCUSSION

There are a number of factors which influence the potential impacts of a former disposal site. The lack of long-range planning and understanding of environmental impacts prior to 1970 led to the use of a large number of small sites in unfavourable settings. Numerous small ravines and worked out sand and gravel pits were used for waste disposal. In recent years development pressures near these disposal sites have increased.

The preliminary field investigation resulted in some general observations of leachate and methane impacts and the factors which affect the impact of older sites. The Verification Study has led to a better understanding of some of these factors.

5.1 Age of Site

Methane

Numerous studies have pointed to the fact that methane gas production does not reach its peak until several years after landfill closure. Our studies show that methane production continues for an indefinate length of time.

The quantity of gas which will be produced at an old landfill site is impossible to determine because of numerous factors controlling production. It appears that all post-war sites produce methane and will produce it for over one hundred years. The quantity can be expected to decrease over that time span. This will gradually reduce the extent of off-site migration. The two oldest sites in this study (Georgetown and East York) still produce significant quantities of methane; however, no off-site migration occurs.

Leachate

The quantity of leachate produced at a site is determined by the amount of infiltration at the site and is not influenced by age. The quality of the leachate is influenced by landfill age. The strength of the leachate will gradually reduce over a period of 100 years or more. The following chart compares expected leachate strength of a young landfill compared to leachate strengths at the three sites studied:

Parameter	Typical Leachate, mg/L Young landfill	Site No. 7060 Georgetown (OW 3) Age(+ 40 years)	Site No.3045 East York (OW 3) Age(+ 30 years)	Site No.7071 Mississauga (OW 4) Age(+ 20 years)
pH	5.0	7.5	7.4	7.6
Conductivity umhos/cm	10000	1450	1890	1230
Hardness	10000	352	597	455
Calcium	1000	17	216.8	279
Magnesium	2000	33.9	35.4	50.0
Sodium	2000	60.4	312.0	123.0
Potassium	1000	9.62	18.6	54.2
Chloride	2000	13.5	123.5	21.0
Sulphate	2000	117.7	9.3	3.1
Nitrate	10	1.68	0.24	0.1
Bicarbonate	6000	576	665	955
Iron	2000	0.1	4.7	0.2
Manganese	500	9.0	1.4	0.30
Ammonia	1000	0.1	0.1	0.1
Kjeldahl	1000	1.7	0.1	0.1
Phosphorous	100	0.1	0.1	0.1
TOC	5000	5	12	33

A general pattern of decreasing leachate strength (for most parameters) with increasing site age is shown by this chart.

The age of site indirectly influences the next factor (refuse composition) as well. In general, the impact of a landfill will decrease slowly with age.

5.2 Refuse Composition

Landfill sites completed prior to the 1960's have a very different composition than those completed after 1970. Burning of waste was prohibited in the 1960's because of environmental concerns. This has resulted in an increased organic content in most disposal sites.

The East York and Georgetown sites contain fill consisting of mostly ash, rubble and a small portion of organic matter. The Mississauga site on the other hand, contained mainly organic domestic waste.

The methane concentrations at these sites reflect the difference in composition. Methane is present at the East York and Georgetown sites but not in sufficient quantities to produce an off-site impact. A potential hazard exists at the East York site only for those residences positioned on the disposal area. No off-site migration was observed. Significant quantities of methane are being produced at the Mississauga site and an off-site hazard has been identified.

In general, no off-site impact is expected at pre-war sites consisting mainly of ash, rubble and burned waste. An impact may be expected when development is allowed on the site itself.

5.3 Site Topography

The three sites have generally flat surfaces, with the exception of East York which has a minor depression for surface drainage to a storm sewer (in the north) and a steep slope to a ravine (in the south). This site has portions of pavement covering it as well. This changes the expected infiltration rate at a site which in turn influence leachate and methane production. Sites with maximum infiltration decompose more rapidly than mounded or covered sites. This increases decomposition. Therefore, they produce more leachate and methane in shorter periods of time. The site water budget including the amount of infiltration expected at this site is included in Section B, 6.0 of the Technical Data Catalogue. The methodology used in these calculations are found in Section A, 3.0 of the Technical Data Catalogue.

A flat surface on a landfill site allows maximum infiltration. Although the Georgetown site has a relatively flat surface, it is completely covered with asphalt allowing no infiltration. The water budget for this site (Section C, 6.0 of the Technical Data Catalogue) shows no infiltration at the site. The excess water is lost as runoff.

The Mississauga site is flat and slightly depressed in elevation from the surrounding area. No runoff occurs at this site, allowing maximum infiltration. The optimum condition effecting the rate of methane production is field capacity. This site is receiving the maximum moisture possible and is probably reflected in the amount of methane produced at the site. (The site water budget is shown in Section D, 6.0 of the Technical Data Catalogue).

5.4 Hydrogeologic Setting

The preliminary study concluded that sites situated in the most permeable deposits (i.e., sand, gravel and fractured limestone) had the greatest off-site impacts. This is true for methane and leachate impacts. The three sites involved in the Verification Study are situated in similar hydrogeologic settings. All are in sand and gravel deposits with low water table situations. Therefore, comparisons between different hydrogeologic settings could not be made.

Due to factors such as age and refuse composition, no off-site impacts were identified at East York and Georgetown even though their hydrogeologic settings are favourable for migration. Migration of methane up to 25 m from the landfill were recorded in the sand and gravel deposits at the Mississauga site.

5.5 Climate

An attempt was made as part of this study to correlate climatic and weather conditions with changes in methane concentrations and migration patterns. The twelve month monitoring program was designed to determine seasonal variations in methane migration.

The climatic data used was obtained from Environment Canada and is included in Section A, 3.0 of the Technical Data Catalogue. No correlation could be made on the effects of pressure systems and precipitation events on gas migration.

Seasonal variations are shown in graph form in the previous sections for each site. The presence of frozen ground cover did not change patterns of migration at the East York and Georgetown site. However, residents at the East York site report odours in their basement in the winter or after rainy periods.

Seasonal patterns for Mississauga show some variations. The concentrations within the landfill vary throughout the year regardless of season. The reason for this is not apparent; however, maximum migration at 2147 Springbank Road does occur in the winter and spring months (November through April, see Figure C-20). Maximum concentrations in some probes bordering the site (GP 7 (shallow), GP 9, GP 10) occur in the winter months, while others (GP 1-s, GP 2-s, GP 3-s, GP 7-d, GP 18-s) have the highest concentrations in the summer months. Based on the Mississauga site, it is apparent that reliable predictions on distance of migration and concentrations cannot be made in sand and gravel deposits. The variations may occur because of changes in refuse composition from one area of the fill to another, higher rates of production during summer months, variations in venting to the atmosphere caused by natural conditions or vent pipes (which do exist in some areas of the site) or variations in surrounding geology.

6.0 CONCLUSIONS

Conclusions drawn from the studies at each site have been indicated previously. The following conclusions relate to the overall results of the Verification Study:

1. All sites generate methane gas for an indefinate period of time.

2. The methodology used in the preliminary study may not identify actual impacts (e.g., East York); however an experienced investigator would establish that a potential impact could exist (based on geologic setting, proximity of development, land uses, age of waste, composition of waste, etc.).

3. Readings of methane gas taken only within the landfill are inadequate (preliminary study methodology). This does not reflect the potential off-site impact of a landfill. For example, methane was found within the Georgetown site but no off-site migration is occurring.

4. Reliable predictions on distance and concentration of migration of gas in sand and gravel deposits can not be made. The variations in migration are probably due to variability in the stratigraphy and permeability of such deposits. Identification of the extent of methane migration in permeable soils will require 6-12 months of monitoring because of the fluctuations of concentrations that were observed.

5. The most significant factors controlling methane migration are i) age of site and ii) geologic conditions. The climatic conditions cause minor fluctuations in off-site migration patterns, but definite seasonal trends are often not apparent.

6. Seasonal changes do not affect decisions on the need for gas control systems or restrictions on building construction near sites.

7. The quantity of methane gas which will be produced at a landfill is impossible to determine because of the numerous factors controlling production. It is safe to assume that methane will be produced in all post-war sites for over one hundred years. The quantity can be expected to decrease over that time span which will gradually reduce the extent of off-site migration (e.g., East York and Georgetown).

8. The quantity of leachate produced will not change unless surface conditions change (e.g., topography, land use and cover conditions). However, the strength of leachate will gradually reduce over a period of one hundred years or more.

7.0 RECOMMENDATIONS

The recommendations for remedial work at each site has been included under the study results for each site. The following recommendations relate to the Verification Study in general.

1. The preliminary study methodology was proven to work for the three sites studied. However, the field studies did not necessarily identify the impact. The experience of the investigators was critical in determining whether or not a hazard existed. If this field methodology is used to study additional sites, it should be carried out by experienced investigators.

2. The factors of i) age of site ii) site geology, iii) refuse composition and iv) proximity of development (as outlined in Section 5.0) should be considered along with preliminary field study results when determining the necessity for further studies at old waste disposal sites.

3. The extent of methane migration at a site can only be determined over a period of 6 - 12 months. The wide range of methane concentrations at the Mississauga site has proven this. The "one-time" methane readings of the preliminary study are not adequate to establish the extent of methane migration.

4. Leachate impacts on groundwater are not expected at most old disposal sites. The preliminary study methodology will only identify impacts in surface water bodies or nearby wells. If delineation of a leachate plume is required, observation wells should be installed. However, we do not feel this is necessary at most old municipal disposal sites.

5. In most cases, the exact limit of fill can not be determined without test drilling. Therefore, where fill limits are not known some test drilling should be done.

6. It is our recommendation that the fill limits and requirements of methane control for all sites be placed in public records.

Morrison Beatty Limited

Project Management: B.W. Beatty
Coordination of
Field Program: N.J. Rennie
Report Preparation: B.W. Beatty
N.J. Rennie

Gore & Storrie Limited

Water Sampling and Water
Quality Analysis

Respectfully submitted,
MORRISON BEATTY LIMITED

B. W. BEATTY

Brian Beatty

Brian W. Beatty, P.Eng.

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central region.

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